RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LIMITED
(A Govt. of Rajasthan undertaking)
(CIN No. U40102RJ2011SGC036861)
GSTIN: 08AAFCR7313H1ZC
Regd. Office: E-166, YudhishthirMarg, C-Scheme, Jaipur-302001
Tel. No. 0141-2225859/2229341.Fax No. 0141-2226028
Website: www.energy.rajasthan.gov.in/rrec; Email: solar.rrec@gmail.com.

SPECIFICATION No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03 (2019-20)

Invitation for Bids

Tenders are hereby invited in e-tender system for construction of following 220/33KV Pooling Sub-stations on turnkey basis. Tenders are to be submitted online in electronic format on website http://eproc.rajasthan.gov.in. The tender document/ specification can be downloaded from above mentioned website.

GENERAL DETAILS:

<table>
<thead>
<tr>
<th>A</th>
<th>NIT No.</th>
<th>No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03 (2019-20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Work Description:</td>
<td>Construction of 4 Nos. 220/33KV Park Pooling Sub-stations (PPS-1, 2, 3 &amp; 4) on turnkey basis in Nokh Solar Park, Village-Nokh, Tehsil-Pokaran, Distt.-Jaisalmer (Rajasthan).</td>
</tr>
<tr>
<td>C</td>
<td>Cost of Tender Specification</td>
<td>Rs. 29,500.00 (inclusive of GST@18%)</td>
</tr>
<tr>
<td>D</td>
<td>Processing Fee of RISL</td>
<td>Rs. 1000.00</td>
</tr>
<tr>
<td>E</td>
<td>Bid Security</td>
<td>Rs. 4,83,80,000.00</td>
</tr>
<tr>
<td>F</td>
<td>Validity of offers</td>
<td>180 days after the date of opening of Techno-commercial bid</td>
</tr>
</tbody>
</table>

IMPORTANT DATES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Events</th>
<th>Date &amp; Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Date of downloading of tender specification</td>
<td>From 27-02-2020 (17.00 Hours) to 02.04.2020 (18.00 Hours)</td>
<td><a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></td>
</tr>
<tr>
<td>(ii)</td>
<td>Last date of Deposit of Cost of Tender Specification, Processing Fee, Bid Security including BG in original, in physical form</td>
<td>Up to 01.04.2020 (15.00 Hours)</td>
<td>Office of the Managing Director, E-166, YudhishthirMarg, C-Scheme, RSDCL, Jaipur.</td>
</tr>
<tr>
<td>(iii)</td>
<td>Date of Pre-Bid Conference</td>
<td>06.03.2020 (11:00 Hrs)</td>
<td>E-166, YudhishthirMarg, C-Scheme, RSDCL, Jaipur</td>
</tr>
<tr>
<td>(iv)</td>
<td>Last date of submission of Pre-Bid Queries by bidders</td>
<td>12.03.2020 (10:00 Hrs)</td>
<td>By e-mail to <a href="mailto:nokhsolarpark@gmail.com">nokhsolarpark@gmail.com</a></td>
</tr>
<tr>
<td>(v)</td>
<td>Date of uploading of Addendum / Corrigendum (if any)</td>
<td>16.03.2020</td>
<td><a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></td>
</tr>
<tr>
<td>(vi)</td>
<td>Last date &amp; time of submission of electronic bid</td>
<td>02.04.2020 (18.00 Hours)</td>
<td><a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></td>
</tr>
<tr>
<td>(vii)</td>
<td>Opening of Technical Bid</td>
<td>03.04.2020 (11.30 Hours)</td>
<td><a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></td>
</tr>
<tr>
<td>(viii)</td>
<td>Opening of Price Bid</td>
<td>To be intimated separately to the qualified bidders</td>
<td><a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></td>
</tr>
</tbody>
</table>
NOTE:-

1. The bidders are requested to submit their bids prior to last date of submission to avoid Non-submission of their bids up to prescribed date due & time to non-availability of/ hanging of website at last moments or any reason whatsoever. The last date of submission of bids will not be extended if system is hang up in last hours or congestion.

2. The bidder shall have to deposit the Cost of tender specification, the Bid Security and the Processing Fee of RISL in Envelope up to stipulated date & time in the office of the Director (Fin.), E-166, YudhishthirMarg, C-Scheme, RSDCL, Jaipur as under:

   i. **Cost of tender specification**: DD/Banker’s Cheque of prescribed amount in favour of MD, RSDCL, Jaipur payable at Jaipur.

   ii. **Bid Security (Rs. 4,83,80,000)**: DD/Banker’s Cheque/BG as under:
       a) 20% amount of prescribed Bid Security by DD/Banker’s cheque in favour of MD, RSDCL, Jaipur payable at Jaipur.
       b) 80% amount of prescribed Bid Security by furnishing Bank Guarantee (in original) on the Rajasthan State Non Judicial Stamp Paper of Rs. 100/- (or as per Govt. norms) purchased in the name of executant’s Bank, duly authenticated either by a first class Magistrate or Notary Public or directly confirmed by the issuing Bankers & shall be valid for atleast 180 days with the grace period of 90 days (Bid Bank Guarantee format is enclosed at Annexure-VIII, Vol-I).

   or
   The bidder may furnish the entire amount of Bid Security by DD/Banker’s Cheque.

   iii. **Processing Fee of RISL**: DD/Banker’s Cheque of prescribed amount in favour of MD, RISL, Jaipur payable at Jaipur.

3. Furnishing of DDs/Banker’s Cheques/Bank Guarantee (as prescribed) towards the Cost of tender specification, the Bid Security and the Processing Fee of RISL up to stipulated date & time in the office of the Director (Fin.), E-166, YudhishthirMarg, C-Scheme, RSDCL, Jaipur is essential for a bidder, otherwise the techno-commercial bid (Cover-I & Cover-II in electronic form on e-proc) of that bidder will not be opened.

4. Technical and Commercial deviations, if any, shall only be mentioned in **Schedule-V “Departure from the Specification” attached with this specification.** Mentioning of such deviations elsewhere in the offer will not be considered as deviation. The printed terms and conditions of firms, if any, attached with the tender will not be considered. RSDCL shall have right to accept or reject these deviations.

5. Offers of bidders without Schedule-I(B), II, III, IV & V & the Price Schedules i.e. Schedule-A (BoQ1), Schedule-B (BoQ2), Schedule-C (BoQ3) & Schedule-D (BoQ4) and without relevant documents as mentioned at clause No. 10 of ITB with respect to qualifying requirements shall not be considered.

6. Any cutting/over writing in the tender documents should be clarified & signed.

7. The prices quoted for all the items as mentioned in ITB Clause No. 16.0 shall be firm only (without any variation).

8. RSDCL reserves the right to wave minor deviation(s), if they do not materially affect the capability of the bidder to perform the contract.

9. Deviation of any kind in the price bid shall not be accepted.

10. The purchaser will respond in writing to any request for clarification on bidding documents which it receives up to stipulated date and time mentioned in the above table.

11. (i) The contractor shall arrange free of charges, suitable accommodation and transport facility for local journey to RSDCL’s representative nominated for inspection.
(ii) For inspection of offered material, contractor shall arrange “To and Fro” Air tickets of
economy class for journey of inspecting officer(s) from nearest airport of the work place
of inspecting officer to their works or the place where inspection is to be carried out and back,
at contractor’s cost after coordinating with the inspecting officer(s). Suitable transport
facility for the inspecting officer(s) from his work place to the nearest airport for “to and fro”
journey will also be arranged by the contractor.

In case, if the place of inspection is not connected through Air, the contractor will arrange
“To and Fro” Air tickets of economy class at their cost up to the nearest Airport of the place
of inspection and onward journey from nearest airport to place of inspection and back by
suitable means i.e. Taxi/ Train (IInd AC class) at the cost of contractor.

In case the place of inspection is within 500 KMs. distance from the headquarter of the
inspecting officer, the contractor will make suitable travelling arrangement up to the
destination of inspection and back by Taxi/ Train (IInd AC class) at contractor’s cost.

No deductions towards air fare/ travelling expenses will be made by the payment making
authority, if the inspection is waived by the competent authority of RSDCL.

12. The bidders are required to furnish the clarification/ confirmation/ documents, if sought by
RSDCL, subsequent to opening of bid within specified time failing which, the case shall be
finalized/decided on the basis of available information. The responsibility of being ignored on
account of delay in furnishing of desired information/documents shall be of the bidder.

13. The tender documents can be downloaded from website http://eproc.rajasthan.gov.in upto
stipulated date & time. Details of this tender notification can also be seen in NIT exhibited on
website www.energy.rajasthan.gov.in/rrecl. Tenders are to be submitted online in electronic
format only on website http://eproc.rajasthan.gov.in.

14. Bidders who wish to participate in this tender enquiry will have to register on
http://eproc.rajasthan.gov.in (bidders registered on eproc.rajasthan.gov.in before
30.09.2011 needs to register again). To participate in online tenders, bidders will have to
procure Digital Signature Certificate (Type-II or Type-III) as per Information Technology Act-
2000 using which they can sign their electronic bids. Bidders can procure the same from any
CCA approved certifying agency i.e. TCS, Safecrypt, Ncode etc. or they may contact e-
Procurement Cell, Department of IT & C, Government of Rajasthan for future assistance.
Bidders who already have a valid Digital Certificate need not to procure a new Digital
Certificate.

Contact No. 0141 – 4022688 (Help desk 10.00 AM to 6.00 PM on all working days)
e-mail: eproc@rajasthan.gov.in
Address: e-Procurement Cell, RiSL, YojanaBhawan, TilakMarg, C-Scheme, Jaipur.

15. Bidders shall submit their offers online in electronic formats both for technical and financial
proposals. However, the cost of specification, Bid security (for 20% amount in the form of
DD/Banker’s Cheque and for remaining 80% amount in the form of BG, as per the format
enclosed at Annexure-VIII, Vol-I of this specification), Joint Venture Agreement in original
(Joint Venture Agreement format is enclosed at Annexure-IX, Vol-I of this specification)
& Power of Attorney for Joint Venture in original (Power of Attorney for Joint Venture
format is enclosed at Annexure-X, Vol-I of this specification, if bidder is willing to participate
in joint venture) and Processing Fee should also be submitted physically upto due date/time
in the office of Director (Fin.), E-166, YudhishthirMarg, C-Scheme, RSDCL, Jaipur.

16. Before electronically submitting the tenders, it should be ensured that all the tender papers
including conditions of contract are digitally signed by the bidder. The check list along with
the relevant page Nos. of various documents shall also be uploaded with the tender.

17. Bidders are also advised to refer “Bidders Manual” available under “Downloads” section for
further details about the e-tendering process.
18. The online tenders will have to be digitally signed and submitted timely on http://eproc.rajasthan.gov.in in the following manner:

**ONLINE SUBMISSION:**

The bidder has to submit their bid in 3 covers comprises of:

**(a) Cover 1 (.pdf):**

It shall contain scanned copy (ies) of

1) DD/Banker’s Cheque of Rs. 29500 (inclusive of GST @18%) in favour of MD, RSDCL, Jaipur payable at Jaipur towards Cost of tender specification.

2) Bank Guarantee of Rs. 3,87,04,000as 80% amount of prescribed Bid Security.

3) DD/Banker’s Cheque of Rs. 96,76,000in favour of MD, RSDCL, Jaipur as 20% amount of prescribed Bid Security
   
   or
   
   DD/Banker’s Cheque of Rs. 4,83,80,000infavour of MD, RSDCL, Jaipur as an alternative for 100% amount of prescribed Bid Security, if Bid Security BG is not submitted.

4) DD/Banker’s Cheque of Rs. 1000 in favour of MD, RISL, Jaipur payable at Jaipur against Processing Fee of RISL.

**(b) Cover 2 (.pdf): Techno-commercial bid (scanned copies) as per clause No. 10 (II) of ITB:**

The techno-commercial information has to be prepared very carefully as indicated in the check list/ clause No. 10 (II) of ITB provided with this specification since it will be the basis for the pre-qualification of bidders. Only relevant and to the point information/ documents should be uploaded. Bidders should neither upload information not requested in the specification nor make any comments. Failure to provide any required information, may lead to the rejection of the offer. Bidder must read the specification very carefully before signing on it. The scanned copy of Joint Venture Agreement, Power of Attorney for Joint Venture shall be furnished, if bidder is willing to participate in joint venture. Documents in support of qualifying requirement etc. must be signed digitally on each & every page by the authorized representative of the firm. After filling requisite information/details desired in the specification &PQR (Pre Qualifying Requirement), the same shall be uploaded with their bid.

**(c) Cover 3 (.xls& .pdf):**

**PRICE BID: BOQs(.xls) [As per clause No.10(III) of ITB].**

This cover consists of price schedules i.e. Schedule-A (BoQ1) for Supply of material/equipments for all Pooling Sub-stations, Schedule-B (BoQ2) for Erection, Testing and Commissioning of all Pooling Sub-stations, Schedule-C (BoQ3) for execution of Civil Works of all Pooling Sub-stations and Schedule-D (BoQ4) for handholding charges of four Pooling Sub-stations. The bidder must quote the prices for all 4 Pooling Sub-stations as covered in the specification. Further, the bidders are advised to read the instructions as indicated on the top of these price schedules and quote the prices accordingly in the prescribed manner.

RSDCL will prepare the abstract of total Prices for complete package towards Supply, Erection, Testing & Commissioning, Civil works and Handholding charges of all Park Pooling Stations i.e. of BoQ1 to BoQ4.

These schedules must be digitally signed by the authorized representative of the firm.

19. Payment shall be made to supplier/contractor through RTGS/NEFT for quick and safe transfer of funds across the country. The charges for transfer through RTGS/NEFT shall be on the part of supplier/ contractor. The supplier/ contractor shall furnish particulars to the payment making authorities of RSCDL in prescribed format to be provided by the purchaser.
20. All the required information shall be furnished strictly in prescribed Schedules/Formats only. Any information indicated other than the prescribed schedules/formats shall not be entertained. The bid shall be evaluated on the basis of information furnished in the prescribed Schedules/Formats.

21. The bidder, if is a Micro, Small or Medium enterprise as per the Micro, Small & Medium enterprise development act, 2006 (MSMED Act-2006) and registered with the authorities under the above Act for the items/services covered under this tender, then the firm has to indicate the Entrepreneurs Memorandum No. (12 Digit) & scanned copy of the certificate issued by the Authorities under the MSMED Act, 2006 should be uploaded along with the online bid.

22. The rates to be quoted by the bidders in BoQs shall be exclusive of GST but inclusive of all other taxes and duties, if any.

23. This specification includes Volume-I (along with Schedules), Volume-II and Volume-III.

24. All the bidders shall provide a list of ‘No Load’ losses and ‘Load’ losses of all the transformers and Bus Reactor including Auxiliary losses with technical bid.

25. The price evaluation shall be done on the basis of “package price” which shall be the abstract of total prices of all the activities i.e. supply, erection, testing & commissioning, civil works and hand holding charges of all the Park Pooling Stations (i.e. summation of the total prices of BoQ1 to BoQ4). For the purpose of comparison of tenders, the quoted prices shall be capitalized for the ‘No Load’ losses and ‘Load’ losses of all the transformers and Bus Reactors including Auxiliary losses at the rate as given at the losses clauses of transformers and Bus Reactors for the penalty/recovery, on the basis of maximum guaranteed losses figures including tolerance, if any.

Director (Technical)
RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LIMITED

PART-I

INSTRUCTIONS TO BIDDERS

(ITB)

FOR

CONSTRUCTION OF 4 NOS. 220/33KV PARK POOLING SUB-STATIONS

AT NOKH, JAISALMER (RAJ.)

No. RSDCL/D(T)/SP/Nokh/PPS/TK/ TN-03 (2019-20)
PART-I

INSTRUCTIONS TO BIDDERS

A. INTRODUCTION

1.0 GENERAL INSTRUCTIONS

1.1. THE RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LTD (RSDCL), JAIPUR, hereinafter called 'OWNER' will receive online bids in respect of construction of 4Nos. 220kV Park Pooling Sub-stations (including SCADA system & FOTE) complete in all respect on turnkey basis, including design, supply of material/ equipments, its successful erection, testing and commissioning, associated Civil works i.e. Control Room Building, Dormitory, GLR, anti-climbing wall, Boundary wall, construction of structure foundations, Railing/ Plinth wall, internal Roads, Gates (Main entry Gate, & Yard Gate etc.), Cattle catcher, Guard hut, Store shed, water harvesting system, Car parking, front lawn, Road outside the main gate (if required), etc and water supply arrangements for operation period including handholding of each Park Pooling Sub-station for 12 months (after commissioning) and handing over of pooling sub-stations to RSDCL as set-forth in the accompanying specification. Bidders shall prepare bids in accordance with the instructions and furnish their offer. This work will be treated as work contract under Section 2 of GST.

2.0 QUALIFYING REQUIREMENT OF BIDDER

Bidder shall be required to fulfill qualifying requirements detailed here under:

2.1 TECHNICAL CRITERIA: FOR POOLING SUB-STATIONS WORK:

EXPERIENCE:

(i) The bidder must have successfully erected, tested and commissioned at least 1 No. of 220kV or above voltage class Grid sub-station or switchyards on turn-key basis within the last seven years, immediately preceding the date of Technical bid opening by supplying at least major material/equipments i.e. Transformer, circuit breakers, switchyard structures, CTs, PTs, CVTs, LAs, Isolators, Control & Relay panels. The bidder should have also executed the associated Civil works of these sub stations/ switchyards to qualify for the Package.

The aforesaid sub-stations or switchyards must have at least two Nos. circuit breaker bays of 220kV class or above, out of which at least one bay should be for controlling of a power Transformer. Also, one sub-station or switchyard must be in satisfactory operation for at least a period of one year as on the date of Technical bid opening on turnkey basis within last seven years immediately preceding the date of Technical bid opening. A circuit breaker bay shall mean the bay having at least one circuit breaker, 2 dis-connectors and 3 Nos. single phase CTs.

For the purpose of considering construction within last 7 years, the date of commissioning/ taking over of above works shall be considered.

The bidder for the Park Pooling Sub-stations work should own or have assured access for the supply of various Equipments/material i.e. Transformers, Circuit breakers, Isolators, Conductors, Earth Wire, CTs, CVTs, PTs, LAs, Battery sets, Sub-station SCADA system (including FOTE), Control & Relay panels, Station Transformers, Insulators, Clamps, connectors & Hardwares, Fans, Lightning fixtures, PLCC Equipments, Communication equipment, Computer system, Laptop/Notebook, Rear Projection LVS system, DCDB, LT Panels, Battery Chargers, Structures, Cables, Marshalling Kiosks and Fire Fighting system from the approved manufacturers (vendors) covered in the list as mentioned in Annexure IIA & IIB of Volume-II of Technical Specification. The bidder shall furnish his own confirmation to the effect that he has assured access from approved manufacturers (vendors) for all the requisite material/ items for construction of Park Pooling Sub-stations commensurate with the completion schedule.
(ii) For meeting this qualifying criteria/requirement, the work done by only one or some of the units/division of a company/firm shall be counted. However, if some units/division are transferred/taken over/acquired by another company/firm, then this work shall not be counted as experience of the acquiring company/firm. Sub contractor’s experience and resources shall not be taken into account in determining the bidder’s compliance with the qualifying criteria. If two companies are merged together then the experience of taken over company will be considered towards qualifying requirement of acquiring company. In case of partnership firms, if complete firm is merged into other firm then the experience of merged firm may be counted towards experience of acquiring firm. If any partnership is dissolved and one or two partners join the other company and remaining partners make a separate company then the experience of acquired or acquiring company will not be considered.

2.2 FINANCIAL CRITERIA:

For the purpose of bid, bidders shall have to meet the following minimum financial criteria:

<table>
<thead>
<tr>
<th>FINANCIAL CRITERIA</th>
<th>Turn-over (Rs.)</th>
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</thead>
<tbody>
<tr>
<td>Minimum average annual turn-over for the best 3 Financial years of last 5 financial Years</td>
<td>100 Crores</td>
</tr>
</tbody>
</table>

2.3 QUALIFYING REQUIREMENTS FOR INDIVIDUAL BIDDER:

The Individual bidder must fulfill strictly all the Technical and Financial requirements as per Clause No. 2.1 to 2.2 above.

2.4 QUALIFYING REQUIREMENTS FOR JOINT VENTURE:

Joint venture (maximum of two firms) fulfilling the following minimum qualifying requirements can also participate in the bid:

(A) TECHNICAL CRITERIA:

(i) The lead partner or the other partner of joint venture shall individually meet 100% of the qualifying criteria given in Clause 2.1 above with furnishing of satisfactory performance of atleast one No. 220kV or above voltage class Grid Sub-station for a period of one year, constructed by them during last 7 years.

(ii) Any one of the partners can be the lead partner.

(B) FINANCIAL CRITERIA:

In case of joint venture, the figures for each of the partners of the joint venture shall be added together to determine the bidder’s compliance with the minimum qualifying criteria set out in Clause No. 2.2 above subject to the condition that lead partner of joint venture must meet not less than 40% of the minimum financial criteria given at Clause No. 2.2 above.

If lead partner alone can meet the financial criteria as stipulated at clause No. 2.2, the other partners may not be required to meet any financial criteria.

Failure to comply with this requirement by the joint venture partners as a whole will result in rejection of the joint venture’s bid.

(C) Bids submitted by a Joint venture firm as partners shall comply with following requirements in addition to all information listed in sub clause No. 2.5:

i) One of the partners shall be nominated as lead partner and the authorization of the Lead Partner shall be evidenced by submitting a power of attorney signed by legally authorized signatories of both the partners (Proforma at Annexure-X).
ii) A copy of the agreement entered into by the Joint Venture partners on the requisite stamp paper shall be submitted with the bid in original or duly attested by a Notary Public (Proforma at Annexure-IX).

iii) The bid may be signed by the lead partner of the joint venture and the Form of J.V. Agreement shall be signed by all the partners so as to be legally binding on all the partners.

iv) The lead partner shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture for execution of the entire contract including payment.

v) All partners of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms and a statement to this effect shall be included in the authorization mentioned under (iv) above as well as in the Bid Form and in the form of agreement (in case of successful bid).

vi) Bid Security, Security Bank Guarantee and Performance Guarantee of a joint venture shall be in the name of lead partner or in the name of the joint venture firms submitting the bid.

vii) Joint Venture Agreement in original & Power of Attorney for Joint Venture in original are to be submitted physically along with the Tender cost, Bid Security & RISL processing Fee in Envelope up to due date and time in the office of Director (Fin.), E-166, Yudhishtir Marg, C-Scheme, RSDCL, Jaipur.

2.5 SUPPORTING DOCUMENTS EVIDENCING CAPABILITIES:

To be qualified for award, bidder/joint venture shall provide satisfactory evidence to the owner towards their capacity and adequacy of resources to implement the contract effectively. Bids shall include the following information:

(a) In order to establish compliance of above financial and technical criteria, the bidder shall furnish original/notarized copy of CA certificate. The CA certificate should also have the membership No. and the address of the Chartered Accountant issuing such certificate. The certificate should be counter signed by the bidder or by authorized representative of the firm and then scanned copy must be uploaded along with online bid. Self-attested copies of Purchase/Work orders, commissioning certificates/taking over certificates/performance certificates from the user/owner, clearly establishing the satisfactorily completion of ordered work(s) and one year performance period shall also be acceptable for evaluating technical criteria.

(b) Authority to seek reference from the bidder’s banks.

(c) Information regarding any current litigation in which the bidder is involved, the parties concerned and disputed amount.

(d) The successful bidder shall be required to submit the plan for carrying out the work.

(e) Details to have all infrastructure, tools & tackles, testing equipments, experienced project manager and sufficient qualified and experienced erection engineers and staff etc. to undertake the job at site along with quality control measurements etc. and complete the same within prescribed time schedule.

(f) The qualification and experience of key personnel proposed for carrying out the work. The Project manager shall have at least 10 years of experience in executing such contract of comparable nature including not less than 5 years as Manager. CV of Project Manager shall be enclosed duly authenticated by signatory.

2.6 OTHER DISQUALIFICATION CRITERIA:

(a) Even though the bidder meets the above qualifying criteria, they are subject to be disqualified if they have:

(i) made misleading or false representation in the forms, statements and attachments submitted in proof of the qualification requirements and/or
(ii) record of poor performance such as incompletion of projects awarded in past/ inordinate delays in completing the contract earlier awarded by RSDCL or litigation history or blacklisting etc.

(b) A bidder can submit only one tender in this tender enquiry either individually or as a partner/lead partner of a joint venture. In case, any bidder furnishes more than one tender in this tender enquiry either individually or as a partner/lead partner of a joint venture then all such multiple bids are liable to be rejected.

2.7 The above stated requirements are a minimum and the owner reserves the right to request for any additional information. Company also reserves the right to reject the proposal of any Bidder, if in the opinion of the owner, the qualification details are incomplete or the bidder is found not qualified to satisfactorily perform the contract then his price bid shall not be opened.

2.8 Company reserves the right to waive minor deviations if they do not materially affect the capability of the bidder to perform the contract.

2.9 Company does not bound itself to accept the lowest or any of the bids and reserves the right to accept any bid or reject any or all bids without assigning any reason thereof.

2.10 Notwithstanding anything stated above, the owner reserves the right to assess Bidder's capability and capacity to perform the contract, should circumstances warrant such an assessment in the overall interest of the owner.

3.0 COST OF BIDDING:

3.1 The Bidder shall bear all costs and expenses associated with preparation and submission of its bid including post bid discussions, technical and other presentation etc. and the Owner will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

B. THE BIDDING DOCUMENTS

4.1 CONTENTS OF BIDDING DOCUMENT:

4.1 The goods and service required, bidding procedures and contract terms are prescribed in the Bidding Document.

In addition to the invitation for bids, the bidding document is a compilation of the following sections:

a) Instruction to Bidders-Section ITB (Vol.I)
b) General Conditions of Contract - Section GCC (Vol.I)
c) Special Conditions of Contract - Section SCC (Vol.I)
d) Erection Conditions of contract - Section ECC (Vol.I)
e) Bid Form (Vol.I) and Price Schedules (BoQs).
f) Technical Specifications for Pooling Sub-station (Vol.II)
g) Technical Specification for Civil works (Vol.III)

5.0 UNDERSTANDING OF BID DOCUMENTS

5.1 A prospective bidder is expected to examine all instructions, forms, terms & specifications in the Bid Document and fully inform himself as to all the conditions and matters which may in any way affect the scope of work or the cost thereof. Failure to furnish all information required by the Bid Document or submission of a Bid not substantially responsive to the Bid Document in every respect will be at the Bidder’s risk and may result in the rejection of its bid.
6.0 CLARIFICATIONS ON BID DOCUMENTS

6.1 If the prospective bidder finds discrepancies or omissions, in the specifications and document or is in doubt as to the true meaning of any part, he shall make a request, in writing, for an interpretation/clarifications to the Owner up to stipulated date and time mentioned in the table of Important Dates (Cover Page). The Owner, then will issue interpretation and clarifications as he may think fit in writing and will upload the same on e-proc website on the specified date. After uploading of such interpretations and clarifications, the bidder may submit his bid but within the time & date as specified in the invitation to bid. All such interpretations & clarifications shall form a part of the Bidding Documents and shall accompany the Bidder's proposal.

Submission of the Bid shall be deemed to be the conclusive proof of the fact that the Bidder has acquainted himself and is in agreement with all the instructions, terms and conditions governing the specification.

6.2 Verbal clarifications and information given by the owner or his employee(s) or his representative(s) shall not in any way be binding on the owner.

7.0 AMENDMENT TO BIDDING DOCUMENT

7.1 At any time, prior to the deadline for submission of bids, the owner may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bidding document by amendment(s). Such revision or amendment, if any will be communicated to all the Bidders through corrigendum(s) on http://eproc.rajasthan.gov.in as amendment or addenda to this invitation of the tender and it shall be binding on them.

7.2 Bidders are required to immediately download any such amendment. It will be assumed that the information contained therein has been taken into account by the bidder in its tender.

7.3 In order to afford prospective bidders reasonable time to take the amendment into account in preparing their bids, the owner may, at its discretion extend the deadline for the submission of bids in which case, the Company will notify all bidders on website of the extended deadline, for submission of tenders.

7.4 Such amendments, clarifications etc, will invariably be considered as a part of the specifications and shall be binding on bidders and will be given due consideration by the bidders while they submit their bids and invariably enclose such documents as a part of the bid.

C. PREPARATION OF BIDS

8.0 LANGUAGE OF BID

The bid prepared by the bidder and all correspondence and documents relating to the bid, exchanged by the bidder and the owner, shall be written in the English/Hindi language, provided that any printed literature submitted by the bidders may be written in other language so long as accompanied by an English/Hindi translation of its pertinent passages. Failure to comply with this may disqualify a bid. For purposes of interpretation of the bid, the English/Hindi translation shall govern.

9.0 LOCAL CONDITIONS

9.1 It will be imperative on each bidder to fully inform himself of all local conditions and factors of sites, including condition of Pooling Stations / land conditions, quality of soil, land levels, availability of water/power/roads/transportation/civil constructional material etc. which may have any effect on the execution of the contract covered under these documents and specifications. The owner shall not entertain any request for clarification from the bidders, regarding such local conditions of sites.
9.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the proposals. No claim for financial adjustment to the contract awarded under these specifications and documents will be entertained by the owner. Neither any change in the time schedule of the contract nor any financial adjustments arising thereof shall be permitted by the owner, which are based on the lack of such clear information or its effect on the cost of the works to the bidder. Any information thus had or otherwise obtained from the purchaser or the Engineer shall not be in any way relieve the Contractor from his responsibility for the supplying of the plant and equipment and executing the work in terms of the contract including all details and incidental works and supply all accessories or apparatus which may not have been specifically mentioned in the contract but necessary for ensuring complete erection, safe and efficient working of Pooling Stations, without any extra cost/charges, if he shall have any doubt as to the meaning of any portion of the general and any special conditions of contract and specifications, he shall before signing the contract or commencement of work, whichever is earlier, set-forth the particulars thereof and submit them to the Engineer in writing in order that such doubt may be removed.

9.3 Work of all 220kV Park Pooling Stations covered under the specification has to be carried out on "As is where is" basis and completed within the given time period.

10.0 DOCUMENTS COMPRISING THE BID TO BE UP-LOADED ON WEBSITE

The Bid shall be accompanied with the following schedules, documents and the fact of their having been uploaded should be as per tender specification. All tenders and accompanying documents will have to be digitally signed and submitted in time as specified on http://eproc.rajasthan.gov.in. The Bid which is not accompanied by any or all of the following schedules, documents or is accompanied by incomplete annexures /schedules is liable for rejection:

I. Cover-1 (.pdf) : FEE (scanned copies)

Following documents are to be uploaded:

(i) Proof of depositing cost of tender specification.
(ii) Proof of submitting processing fee.
(iii) Proof of depositing of complete Bid Security

II. Cover-2 (.pdf): TECHNO COMMERCIAL BID (scanned copies)

Following documents are to be uploaded:

(i) **Status of the Bidder**
   Confirmations regarding the status of the bidder i.e. whether the bidder is a individual Firm or a joint venture Partner of Firms, as per the provisions of the Qualification Requirements of the tender documents.

(ii) **Details of Past Supplies (Schedule-IV)**
   Details of past supply/ experience of having constructed the required number of 220 KV or above voltage class sub-station on turnkey basis, as specified at Clause No. 2.1 of ITB i.e. Qualification Requirements of the tender documents. Relevant supporting documents are to be furnished.

(iii) **Performance criteria**
   Performance Certificates in respect of required number of 220 KV or above voltage class sub-station on turnkey basis, as specified at clause No. 2.1 of ITBi.e. Qualification Requirements of the tender documents.

(iv) **Assured access**
   Confirmation regarding bidder having the assured access for supply of various equipments/material as specified at clause No. 2.1 of ITB i.e. Qualification Requirements of the tender documents.
(v) **Financial Criteria**
Details regarding meeting the financial criteria in respect of minimum average Annual turnover for the best three financial years of last 5 financial years. This shall be according to the provisions specified for the individual and the joint venture partners. The scanned copies of supporting documents for the same shall be uploaded as detailed below:-

(a) CA Certificate indicating the Annual turnover of the firm for best 3 years in the last five years. The CA certificate should have membership number (UDIN No.) and address of the Chartered Accountant issuing such certificate.

(b) Balance sheet of the firm for last five years.

(vi) **Schedule-I (B)**
Confirmations regarding validity of offers, Prices, quantities, completion period and the terms & conditions as well as technical stipulations of the tender specification.

(vii) **Bid–Form(Schedule-II)**
Duly signed Bid Form as per Schedule-II.

(viii) **Schedule-III**
Information required from firms along with their Techno-Commercial Bid.

(ix) **Annexure-IX & X:**

(x) **Current Litigation**
Information regarding any current litigation in which the bidder is involved, the parties concerned and disputed amount involved, as per clause No. 2.5(c) of ITB, Vol-I.

(xi) **Details of infrastructure**
Details to have all infrastructures, tools & tackles, testing equipments along with experienced project manager and qualified erection engineers etc. as per clause No. 2.5(e) of ITB, Vol-I.

(xii) **Key personals**
List of qualified key personal to carry out the work as per clause No. 2.5(f) of ITB, Vol-I.

(xiii) **Schedule-V**
Deviations from Purchaser’s specification (Technical & Commercial) in Schedule-V of Tender Documents. Deviations indicated elsewhere will be ignored.

(xiv) **Confirmation of GTP**
Confirmation to supply the various equipments/material for Park Pooling Stations as per technical particulars of various equipments/material attached with technical specification, Volume-II.

(xv) **Confirmation for supply of equipments/material from approved vendors**
Confirmation to supply the various equipments/material for Park Pooling Stations from the approved vendors indicated in Annexure-II(A) & II(B) attached with the technical specification, Volume-II.

(xvi) **Bidder’s contact details**
Name & correspondence address of the bidder along with phone/Fax No. & e-mail address.

(xvii) **Other details/information, if bidder requires to furnish.**
The above information should be prepared very carefully since it will be the basis for the pre-
qualification of bidders. Only relevant and to the point information shall be indicated. Failure to
provide any required information may lead to the rejection of the offer. All above documents are
to be digitally signed on each & every page by the authorized representative of the firm after
filling requisite information/details as desired in the specification &PQR. Departure from
specification (Technical & Commercial) shall only be given in Schedule-V. Deviations indicated
elsewhere will be ignored.

All documents should be arranged in above order at one place and a list of the furnished
documents be indexed in a table.

III. Cover-3 (.xls) : (a) PRICE BID: PRICE SCHEDULES(.xls)

(a) Schedule-A (BoQ1) for Supply of material/equipments for all Pooling Sub-stations,
Schedule-B (BoQ2) for Erection, Testing and Commissioning of all Pooling Sub-stations,
Schedule-C (BoQ3) for execution of Civil Works of all Pooling Sub-stations and Schedule-
D (BoQ4) for handholding charges of four Pooling Sub-stations.

These schedules must be digitally signed by the authorized representative of the firm.

11.0 SCOPE OF THE PROPOSAL

11.1 The scope of the proposal shall be on the basis of a single bidder or lead partner in case of
joint venture responsibility for construction of 4 Nos. 220kV Park Pooling Sub-stations
(including SCADA & FOTE) on turnkey basis as indicated in clause No. 1.1 of the SCC
completely covering design, engineering, supply of material, equipments, its successful
errection, testing and commissioning and associated civil works including anti-climbing wall,
Boundary wall, Railing/Plinth wall, front lawn, internal Roads, Gates (Main entry gate &
Yard gate etc.), cattle catcher, Guard hut, store shed, car parking shed, structure
foundations, CRand Dormitory buildings and rain water harvesting system, GLR, Road
outside the main gate (if needed), etc. and water supply arrangements for operation period&
handholding of each Park Pooling station for 12 months (after commissioning) as specified
under the accompanying commercial and technical specification. It will include the
following:-

a) All design, engineering of all 4 Nos. 220/33kV Park Pooling Sub-stations.
b) Detailed design and drawings of material/ equipments, structures, foundation design/
drawings of equipments and switchyard structures and design/drawings of civil works
of Park Pooling Sub-stations.
c) Providing of all type of engineering, construction drawings related to construction of
220kV Pooling Stations and execution of civil works of Pooling Stations, technical data
for owner’s approval.
d) Vendor & subcontractor’s name for owner’s approval.
e) Complete manufacture, assembly including shop testing, inspection and testing of
material and equipments (before supply and delivery).
f) Packing & transportation of equipments, material from manufacturer works to Park
Pooling Stations site.
g) Receipt, storage, preservation and conservation of Pooling Station and equipments at
sites.
h) Pre assembly if any, erection of sub-station, successful testing and commissioning of all
equipments, illumination of Pooling Station (s) on turnkey basis.
i) Reliability tests and performance & guarantee tests on, Pooling Station and equipments
and items on completion of erection / commissioning.
j) Execution of civil works of Pooling Stations as per specification including anti-climbing
wall, Boundary wall, Railing/Plinth wall, Gates (Main entry gate & Yard gate etc.),
cattle catcher, Guard hut and water supply arrangements for operation period.
k) In addition to above, handholding of each Pooling Station for 12 months and the scope
for Pooling Stations work shall also be as per details indicated in Volume-II, III.

11.2 No deviation whatsoever to certain conditions of the bidding documents as specified in
clause No. 4 of the Special Conditions of Contract (SCC) is permitted by the Owner and
therefore, the bidders are advised that while making bid proposals and quoting prices, these conditions may appropriately be taken into consideration. Bidders are required to furnish a certificate in this regard in the bid form. Any bid not accompanied by such certificate shall be rejected by the owner.

11.3 Bids not covering the above entire scope of works may be treated as incomplete and hence may be rejected.

12.0 BID PRICE

12.1 (a) The bidder shall quote prices on FOR site basis for supply of material/equipments in respective schedule of prices (Schedule-A i.e. BOQ1) available in cover-3 (.xls) of Specification. The rates/ prices quoted shall include the following:

(i) Packing and forwarding charges.
(ii) Insurance charges.
(iii) Freight charges including loading/unloading & stacking.
(iv) All duties & Taxes, excluding GST.

(b) For Erection, Testing & commissioning, Civil works and Handholding charges, the bidder should quote their unit prices including all taxes/duties & other charges but excluding of GST as per ITB Clause-15 in the respective schedule i.e. Schedule-B (BOQ-2 for Erection, Testing & Commissioning), Schedule-C (BOQ-3 for CIVIL works) and Schedule-D (BOQ-4 for Handholding) available in cover 3 (.xls) of specification.

12.2 The bidder shall quote the prices of all the material, equipments& works required for construction of all 4 Nos. 220/33kV Park Pooling stations and for execution of their related Civil works and handholding charges (for 12 Months period) of Pooling stations as per provisions of specifications along with unit rates in the schedules enclosed with the specification Volume-I.

For the purpose of quoting the prices, tentative Bill of Material (BoM) for switch yard portion of works has been indicated in the Price-schedules (BoQs) as well as in the specification Section-I, Volume-II and description of civil works has been indicated in Volume-III. Any additional item/material/equipment or works/activity, if any, not indicated in the above Bill of Material/description of works in schedule of prices enclosed with the specification Volume-I and is required for completion of Pooling stations as per provisions of specifications, the prices of those additional material, equipments/ works/ activity shall be deemed to have been included in the quoted prices by the bidder in the relevant price Schedules.

13.1 ALTERNATE PROPOSALS

The bidder shall quote their proposals strictly conforming to the technical details, design as specified in the specification. Any offer based on the alternate design shall not be considered. Alternative proposals, if any, shall be clearly stated in the covering letter and shall accompany each copy of the Bid.

14.0 PRICE BASIS

14.1 The bidder shall quote price for the entire scope of works covered under the Technical and Commercial specification as required in the bid proposal sheets. The prices of all items are required to be quoted on “FIRM PRICE” basis, independent of any variation.

14.2 Bidder shall indicate bid prices only in Indian Rupees. Prices indicated in foreign currency shall not be accepted and the bid will be rejected out rightly.

15.0 TAXES, DUTIES & LEVIES:
15.1 All taxes, duties/levies as per Govt. rules payable by the bidders in respect of the transaction between the bidder and their vendors/sub-suppliers while procuring any components, sub-assemblies, raw-materials and equipment shall be included in the bid price and no extra claim on this behalf will be entertained by the owner. The prices of all the items shall be quoted by the bidder in the price Schedules enclosed with this specification.

15.2 All taxes & other levies except GST in respect of the transactions between the owner and the contractor under the contract, shall be included in the bid price and shall be quoted by the bidder in the price Schedules enclosed with the specification.

15.3 The TDS Income tax and surcharge on Income tax will be deducted from the bills/invoices of the contractor at the prevailing rates and as per the applicable laws on the composite value of contract consisting of prices for supply of material/equipments, erection, testing, commissioning charges and prices for execution of civil works. However, necessary TDS certificate(s) shall be issued by Company’s Paying Authority. Any liability arising on account of Income Tax will be to the contractor’s account. Any statutory variation in the Income Tax will be to the contractor’s account.

15.4 The owner reserve the right to split the contract to successful bidder for construction of 220 kV Pooling Sub-stations in three-parts viz.

(i) Supply of material and equipments & maintenance tools, if any, for construction of Pooling Sub-stations.
(ii) Erection, testing & commissioning work for construction of Pooling Sub-stations.
(iii) Execution of Civil Works for construction of Pooling Sub-stations.

15.5 **GST TDS**

The GST TDS under Section-51 will be deducted from the bills/invoices of the contractor at the applicable rates at the time of payment on the composite value of the contract consisting of prices for supply of material/equipments, erection testing commissioning charges and prices for execution of civil works.

15.6 All contracts/contractors with the Govt. shall require registration of workers under the Building & other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and extension of benefit to such workers under the Act. Deductions of Cess at source will be made as per provisions of the said Act, in force from time to time.

15.7 Any new tax or duty, if imposed by the Govt. after submission of tender but during contractual completion period shall be paid by RSDCL at actual against documentary proof. After contractual completion period, any new tax or duty, if levied, shall be borne by the contractor and not by RSDCL.

15.8 **ROYALTY:**

In pursuance of the Notification issued by Department of Mines, Govt. of Rajasthan vide circulars dated 15.11.11, 18.10.12 & 09.01.13 regarding Royalty Tax determination and deposition of the same in the Department of Mines & Geology, the Contractor shall be responsible for legitimacy of the civil material used in construction of Park Pooling Stations. The Contractor shall also be responsible for compliance of the instructions contained in the said circulars and further amendments, if any. The payment of RA bills shall be made after ensuring compliance of the guidelines contained in the above circulars by the contactor.

In case any liability/dues against royalty is finalized by the Department of Mines, GoR, the contractor shall be fully responsible for making payment of such dues to the Mining Department or the same may be deducted/recovered by the RSDCL from the financial hold of the contractor available with RSDCL under this contract or any other contract.
All contracts/ contractors with the Govt. shall require Registration of workers under the
Building & other Construction Workers (Regulation of Employment & Conditions of
Service) Act, 1996 and extension of benefit to such workers under the Act. Deductions of
cess at source will be made as per provisions of the said Act, in force from time to time.

16.1 PRICE ADJUSTMENT: The quoted prices shall be ‘FIRM’ only.

17.0 TIME SCHEDULE

17.1 The basic consideration and the essence of the Contract shall be strict adherence to the
time schedule for performing the specified works.

17.2 The owner’s requirements of completion schedule for the works are mentioned in the
accompanying Special Conditions of Contract (SCC).

17.3 The completion schedule as stated in the Special Conditions of Contract shall be one of the
major factors in consideration of the bids.

17.4 The owner reserves the right to request for a change in the work schedule during pre award
discussions with successful bidder.

17.5 The owner reserves the right to defer the completion period. The period so deferred shall not
be reckoned as delay in completion of contract in terms of clause ‘Recovery for Delay in
completion of contract.’

17.6 The contractor shall prepare and finalize the L-2 network (Project Implementation Schedule)
with the owner within 15 days from the date of acknowledgement of the LOA. The L-2
network shall be in line with the work completion schedule and indicate the schedule for all
major and critical activities covered under the contract (scope of work) as per the
requirement of Clause 12.0, Section GCC.

17.7 The L-2 network will cover different areas such as finalization of sub-vendor, Quality plan,
Engineering activities, inspection, manufacturing and supply of Sub-station material/
equipments, civil & erection works, testing and commissioning, RSDCL’s obligations etc.

17.8 Once L-2 network has been finalized, no revision shall normally be permitted therein as
long as basic scope of work remains unchanged. However, in such a case, increase in
quantities, while executing the work as per original scope, shall be suitably adjusted
without affecting the overall completion schedule.

17.9 Non availability/ scarcity/ non-allocation of raw material shall not constitute as a ‘force
majeure condition’ in any case and it will be sole responsibility of the Contractor to
arrange the raw material for timely execution of the order.

17.10 If the basic scope of work undergoes changes during execution stage resulting into
additional scope over that originally provided for which the contractor insists for
additional/separate completion period/schedule, such extra completion schedule along
with L-2 network for the same shall be finalized in consultation with the contractor.

17.11 In case the scope of work does not change but the contractual completion period is
extended because of delay in commencement/execution of the work on account of non-
fulfillment of obligations by RSDCL or any other reason not attributable to the contractor,
L-2 network shall be suitably revised as per the extended completion period. Once the
contractual completion period is extended, revised L-2 network shall be finalized.

17.12 The schedule for all engineering activities viz, drawing(s) approval, witness and approval of
type tests including witness/review of routine tests prior to type test etc., finalized in L-2
network, shall be the reference to monitor progress of Engineering activities.

17.13 The availability of construction drawings being the basic input for proceeding ahead with
site activities, all care shall be taken to ensure that different activities in this regard are
completed by the contractor within the time frame specified in the contract/L-2 network for the same in a sequential manner.

18.0 CONTRACT QUALITY ASSURANCE

18.1 The bidder shall include in his proposal, the quality assurance programme containing the overall quality management & procedures which he proposes to follow in the performance of the works during various phases as detailed in relevant clause of the General Technical Conditions.

19.0 INSURANCE

The bidder’s insurance liabilities pertaining to the scope of works are detailed out in clauses titled insurance in General terms and conditions of contract and in Erection conditions of contract of this volume-I. Bidder’s attention is specifically invited to these clauses; bid price shall include all the cost in pursuance of fulfilling all the insurance liabilities under the contract.

20.0 MAINTENANCE TOOLS AND TACKLES

Maintenance tools & tackles, if any as per requirement shall be supplied by the contractor.

21.0 ERECTION TOOLS AND TACKLES

The bidder/supplier shall supply all special equipment, tools & tackles etc. which he finds necessary for the purpose of erection, handling, testing & commissioning including performance and guarantee tests of the equipments.

22.0 BRAND NAMES

The specific reference in these specifications and documents to any material/ equipment by brand name, make or catalogue number shall be construed as establishing standards of quality and performance and not as limiting competition. The equipments/items indicated in Annexure-II(A), Vol.II of specification shall be supplied from the vendors specified against each equipment/item only. However, for the equipments/items appearing in Annexure-II(B), Vol.II of specification, in case the bidder opts for the vendors other than specified against each equipments/items then such vendor should fulfill minimum qualifying criteria as per foot note appearing under Annexure-II(B), Vol.II of specification. For other items (not appearing in Annexure-II(A) & II(B), Vol.II of specification), bidders may offer material/ equipment with make, provided they meet the specified standard, design and performance requirements. The bidder shall furnish adequate technical information about such alternative/additional material/ equipment manufacturer(s) to enable the Owner to determine its acceptability. The Owner shall be the sole judge on the acceptability or otherwise of such alternative vendors.

23.0 BID SECURITY (EMD)

23.1 The bidder shall furnish as part of its bid, the bid security both in DD/Banker’s Cheque and in the shape of BG for an amount as specified at Clause No. 2 of the accompanying Special Conditions of Contract.

23.2 The bid security is required to protect the Owner’s interest against the risk of bidder’s conduct which would warrant forfeiture of bid security, in pursuance to para 23.7 below.

23.3 The bid security shall be denominated in Indian Rupees only and shall be furnished in the shape of BG from an Indian scheduled/nationalized bank for 80% amount of Bid Security (which shall be in the favour of MD, RSDCL) on the Rajasthan State Non Judicial Stamp Paper of Rs.100/- (or as per GoR rules) purchased in name of the executant’s Bank duly authenticated either by a first class Magistrate or Notary Public or directly confirmed by the issuing Bankers shall be furnished with the validity of atleast 180 days with a grace period of 90 days (Bid bank guarantee format is enclosed at Annexure-VIII, Vol. I).The balance 20% amount shall be deposited in by DD/Banker’s Cheque in favour of MD, RSDCL, Jaipur
payable at Jaipur for the amount as specified at Clause No. 2.0 of the SCC. The bidder may also furnish entire amount of Bid Security in DD/Banker’s Cheque, if he so desires.

23.4 Any Bid not accompanied by a copy of receipt for Bid Security (Demand Draft/Original Bid Bank guarantee) shall be rejected and the Bid will not be opened. Any bid not secured in accordance with para 23.1 and 23.3 above will be rejected by the Owner as non responsive.

23.5 In case of unsuccessful bids, the Bid Security (EMD) will be refunded within 30 days after finalization of the tender and placement of detailed purchase order on the successful bidder.

23.6 The bid security of successful Bidder will be discharged after execution of Contract Agreement and furnishing of Security & Performance Guarantees.

23.7 The bid security may be forfeited:

(a) If a bidder withdraws its bid during the period of bid validity specified by the Bidder on the Bid Form; or

(b) In the case of a successful Bidder, if the Bidder fails:
   (i) to sign Contract agreement or
   (ii) to furnish the security & performance Guarantees.

23.8 The proof for furnishing bid security shall be submitted along with the bid. Any bid not accompanied by the required bid security in accordance with provisions of this clause will be rejected by the Owner and shall not be opened.

23.9 No interest shall be payable by the Owner on the above bid security.

24.0  PERIOD OF VALIDITY OF BIDS

24.1 Bids shall remain valid for a minimum period of 180 days after the date of opening of techno-commercial bid. A bid valid for a shorter period will be rejected by the Owner as non responsive.

24.2 In exceptional circumstances, the Owner may solicit the bidder’s consent to an extension of the period of validity. The request and the response thereto shall be made in writing (including cable or telex or Fax/email). The period for return of bid security amount provided under Clause 23.0 shall also be extended by the same period as the extension in the validity of the bid. A bidder granting the request will not be required or permitted to modify its bid.

25.0  BID FORMAT, SUBMISSION AND OPENING OF BIDS

(a) Bidder shall submit his bid online in electronic format digitally signing the same. Bidder shall procure Digital Signature Certificate (DSC) as per IT Act - 2000.

(b) The documents listed in ITB (Instructions To Bidders) clauses, along with addendum’s issued till the date & time of bid submission, shall be filled by the bidder to bind the bidder to contract. All pages of the bid shall be stamped and digitally signed.

(c) All omissions in the price schedule, will be serially numbered and digitally attested by the officer opening the bid, so as to make further dispute impossible on this score.

(d) Bidders who have to participate in this tender will have to register on http://eproc.rajasthan.gov.in. Further, bidders who have to participate in online tenders will have to procure digital signature certificate as per IT act so that they can sign their electronic bids.

(e) Before electronic submission of tender, it should be ensured that all documents, Schedules, Annexures, certificates, informations etc. of the tender specification are digitally signed by the bidder.
(f) All tenders, in which any of the prescribed conditions are not fulfilled may liable to be rejected.

(g) The electronically received bids will be opened in the office of the Director (Tech.)/ Conference Room on stipulated date & time in the presence of such bidders or their authorized representative, who choose to be present. The system does not permit electronic submission of late tenders after the due date & time.

(h) The Bid shall not be witnessed by a bidder who himself have not participated.

(i) Should the date fixed for opening of the Bids is declared as a public holiday, the Bids shall be opened on the next date on which office re-open after such holiday(s).

26.0 SIGNATURE ON BIDS

The Bid must contain the name, designation and place of business of the person or persons making the Bid and must be submitted online, placing them in 3 covers after filling & signing digitally with his DSC (Digital signature). Bid by a partnership firm must be furnished with full names of all the partners and should be signed digitally by one of the member of partnership firm or by a authorized representative indicating the designation of the person or persons, with authority letter signed by the Chairman/Secretary or other person authorized to bind the Corporation/Company in the matter.

27.0 DEADLINE FOR SUBMISSION OF BIDS

27.1 Bids must be received online by the owner on the website http://eproc.rejasthan.gov.in upto the specified date & time as mentioned in the cover page but not later than the time and date mentioned in the invitation to bid.

27.2 The Owner may, at its discretion, extend this deadline for the submission of bids by amending the bidding document in which case all rights and obligations of the owner and bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

27.3 Should the date fixed for opening of the Bids is declared as a public holiday, the Bids shall be opened on the next date on which office re-open after such holiday(s).

28.0 MODIFICATION AND WITHDRAWAL OF BIDS

28.1 The bidder will not be allowed to withdraw its bid/offer after its submission. However, the bidder may modify its bid prior to the deadline prescribed for submission of bids.

28.2 Withdrawal of bid after its submission and modification of the price bid during the interval between the deadline for submission of bids and expiration of the period of validity specified by the bidder on the bid form may result in the bidder's forfeiture of its bid security.

29.0 INFORMATION REQUIRED WITH THE PROPOSAL

29.1 The bidder must clearly indicate the name of manufacturer, the type of model of each principal item of equipment proposed to be furnished and erected. The bidder shall also furnish the drawings and descriptive materials indicating general dimensions, materials from which the parts are manufactured, principals of operation, the extent of pre assembly involved, major construction equipment proposed to be deployed, method of erection and the proposed erection organisational structure.

29.2 The above information shall be provided by the bidder in the form of separate sheets, drawings, catalogues, etc.
29.3 Bid must contain sufficient descriptive material as per tender specification to describe accurately the equipment proposed. Such descriptive material and drawings submitted by the bidder will be retained by the owner. Any major departure from these drawings & descriptive material submitted will not be permitted during the execution of the contract without specific written permission of the owner.

29.4 Oral statements made by the bidder at any time regarding quality, quantity or arrangement of the equipment or any other matter will not be considered.

29.5 Standard catalogue pages and other documents of the bidder may be used in the bid to provide additional information and data as deemed necessary by the bidder.

29.6 In case the "proposal" information contradicts specification requirements, the specification requirements will govern, unless otherwise brought out clearly in the technical commercial deviation schedules (Schedule-V). Deviations indicated elsewhere except these schedules shall not be considered.

29.7 Dimensional drawings indicating the general and/or detailed constructional features/cross sectional views/assembling or dismantling, schematic arrangement/ curves and charts/ lay out for the material and its erection and commissioning and use wherever specially required under Volume-II of this specification shall be furnished along with the Bid.

29.8 Notwithstanding anything contained in sub para 29.7 above, the bidder may also furnish such drawings which according to him are desirable for the material/ equipment offered.

29.9 The purchaser may require the drawings as furnished by the bidder to be modified to suit the requirements of the specification. The approval of final drawings shall be necessary and binding and the supplier shall conform to the same.

29.10 In the event of order, the contractor shall furnish the original/notarized photostat copies of the latest type test certificates from a Govt./Govt. approved/ Govt. recognized/ NABL accredited test lab/ILAC i.e. International Laboratory Accreditation Co-operation (in case of foreign laboratories) or the certificate of type test conducted at manufacturer's works duly witnessed by representative of any Electricity Board or Company/ Govt. agency/ PGCIL/NTPC (wherever specified in technical specification for particular items) or the certificate of type test conducted in the manufacturer's own lab located in the foreign country duly witnessed by independent agency for all the type tests wherever prescribed in the relevant latest editions of Indian standards/International standards (as applicable in terms of Volume-II&Volume-III of this specification). The type test certificates should not be older than 7 years as on the date of Technical bid opening for which the date of conducting of test will be considered. However no separate type test charges shall be paid to the bidders.

29.11 In case of any specific alternative requirement of type test, the same shall be furnished as per Volume-II of this specification.

29.12 The successful bidder/supplier shall be required to furnish the routine/manufacturer(s) factory test certificate(s) for the test carried out during manufacture in accordance with the latest standard specifications.

D. BID OPENING AND EVALUATION

30.0 OPENING OF BIDS BY OWNER

30.1 The owner will open bids (Techo-commercial part) online on specified date & time on the website as mentioned in the cover pages.

30.2 The price bid of only technically & commercially qualified bidders shall be opened online on subsequent dates. The time & date of opening of price bid shall be conveyed to the qualified bidders separately.
31.0 CLARIFICATION OF BIDS

To assist in the examination, evaluation and comparison of bids, the owner may, at its discretion, ask the bidder for a clarification of its bid. The request for clarification and the response shall be in writing and no change in the price or substance of the bid shall be sought, offered or permitted.

32.0 PRELIMINARY EXAMINATION

32.1 The Owner will examine the bids to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed, and whether the bids are generally in order.

32.2 Before opening the price bid of competent bidders, the competency of bidders shall be decided on the basis of their past experience, meeting the specified qualifying requirement, commercial & technical specification.

32.3 If any arithmetical error(s) is found in price bid, the same shall be rectified for the purpose of evaluation & comparison of bids and for placing orders. If there is discrepancy between the quoted unit price/ total price and the unit price/total price worked out on the basis of quoted ex-works price plus taxes, quantities etc. then the price which is beneficial to RSDCL shall be considered.

The bidder should ensure that the prices furnished in various price schedules are consistent with each other. In the case of any inconsistency in the prices furnished in the specified price schedules to be identified in Bid Form for this purpose, the owner shall be entitled to consider the highest price for the purpose of evaluation and for the purpose of award of contract, the lowest of the prices in these schedules shall be used.

32.4 Prior to the detailed evaluation, the owner will determine the substantial responsiveness of each bid to the bidding document. For purpose of these clauses, a substantially responsive bid is one which conforms to all the terms & conditions of the bidding document without material deviations. A material deviation is one which affects in any way the prices, quality, quantity or delivery period of the equipment or which limits in any way to the responsibilities or liabilities of the bidder of any right of the owner as required in these specifications and documents. The Owner’s determination of a bid’s responsiveness shall be based on the contents of the bid itself without re-course to extrinsic evidence.

32.5 A bid determined as not substantially responsive will be rejected by the owner and may not subsequently be made responsive by the bidder by correction of the non-conformity.

32.6 The owner may waive any minor informality or non or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any bidder.

33.0 EVALUATION & COMPARISON OF BIDS

33.1 The bids shall be compared on the basis of package price for the entire scope of the proposal as defined in the bidding document in respect of supply portion and the prices for the erection, testing, commissioning, civil works and handholding charges.

33.2 For comparison purposes, all the evaluated bid package prices shall be in Indian Rupees.

33.3 All evaluated bid package prices of all the bidders shall be compared among themselves to determine the lowest evaluated bid and, as a result of this comparison, the lowest bid will be selected for the award of the Contract. The package price includes the cost of all the Four Pooling Sub-stations for supply portion & the prices for the erection, testing, commissioning and civil works including the charges of handholding as per specification. The loading of quoted Transformers and Reactors losses shall also be done for price evaluation.
33.4 Incase, it is found in the price bid that the bidder has not quoted for some of the item(s) indicated in the BoM of specification, in that case, no loading for such item(s) shall be done for the purpose of evaluation and comparison of bids. In the event of order, prices of such item(s) will be treated ‘Zero’ and no payment will be made for such item(s) against supply or other works.

34.0 CONTACTING THE OWNER

Bids shall be deemed to be under consideration immediately after they are opened and until such time, official intimation of award/rejection is made by the owner to the bidders. While the bids are under consideration, bidders and/or their representatives or other interested parties are advised to refrain from contacting by any means, the owner and/or his employees/representative on matters related to the bids under consideration. The owner, if necessary, will obtain clarifications on the bids by requesting for such information from any or all the bidders, either in writing or through personal contacts as may be necessary. Bidders will not be permitted to change the substance of the bids after the bids have been opened.

E. AWARD OF CONTRACT

35.0 AWARD CRITERIA

35.1 The owner will award the contract to the successful bidder(s) whose bid has been determined to be substantially responsive and has been determined as the lowest evaluated bid, provided further that the bidders determined to be qualified to perform the contract satisfactorily. The owner shall be the sole judge in this regard.

35.2 In case of supply contract, the award shall be on the basis of FOR destination (site) basis.

35.3 Further, the owner reserves the right to award separate contracts to two or more parties in line with the terms and conditions specified in the accompanying technical specifications.

35.4 Further, the owner reserves the right to award the contract to successful bidder(s) in three parts viz. supply of material/equipments for construction of substation(s) (part-I), erection, testing and commissioning of substation(s) (part-II), execution of civil works of sub-station(s) (part-III), on turnkey basis. Notwithstanding the breakup of the contract price, the contract, at all times, shall be construed as a single source responsibility contract and any breach in any part of the contract shall be treated as a breach of the entire contract.

36.0 OWNER’S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS.

The owner reserves the right to accept or reject any bid, to annul the bidding process and reject all bids at any time prior to award of contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the owner’s action.

37.0 NOTIFICATION OF AWARD

37.1 Prior to the expiration of the period of bid validity and extended validity period, if any, the owner will notify the successful bidder(s) in writing by registered letter or by cable or telex or email, to be confirmed in writing by registered letter, that its bid has been accepted.

37.2 The notification of award will constitute the formation of the contract.

38.0 SIGNING OF CONTRACT

38.1 At the same time, as the owner notifies the successful bidder that its bid has been accepted, the owner will send the bidder the detailed letter of Award, incorporating all agreements between the parties. The Contractor shall have to execute the contract documents within a period of 15 days from the date of issue of the order(s), in prescribed form (copy enclosed) on
Rajasthan State Non-judicial stamp paper of appropriate worth as per stamp duty applicable in Govt. of Rajasthan along with copy of the order, copy of General Conditions of Contract, Special Conditions of Contract including Erection & Civil, Technical specification. It is advised that each and every page of relevant documents is to be signed by authorised person. It may however be ensured that one copy of the order and other documents as above, are signed by an authorised person holding valid power of attorney and returned to the Director (Tech.), RSDCL, Jaipur. The power of attorney on non-judicial stamp paper worth Rs. 100/- (attested by the Notary Public) in favour of person signing these documents, duly notarized in original be also submitted alongwith the above documents.

38.2 Within 15 days of receipt of the detailed letter of Award, the successful bidder shall sign and date the same and return it to the owner. The receipt of above documents and the same being in order shall be notified by the Director (Fin), RSDCL, Jaipur in due course of time under intimation to the Director (Tech.), RSDCL, Jaipur. No payment shall be released without acceptance of the Contract Agreement, performance bank guarantee, security bank guarantee and approval of Project Implementation Schedule (L-2 Network).

38.3 The bidder will prepare the Contract Agreement as per the proforma enclosed at Annexure-V(A) & V(B) to this Volume-I and the same will be signed within 15 (fifteen) days from the date of issue of order(s).

38.4 The Contractor and COMPANY shall as soon as possible, unless otherwise agreed upon, enter into a signed agreement for the proper fulfillment of the contract. The expenses of completing and stamping the agreement shall be paid by the Contractor and the COMPANY shall be furnished free of charge with an executed stamped agreement after the Bid has been accepted by the COMPANY. All orders/ instructions to the Contractor shall, except as herein otherwise provided, be given by the Engineer on behalf of the COMPANY.

39.0 SECURITIES (DEMAND DRAFT/ BANK GUARANTEES)

COMMON FOR ALL TYPES OF BANK GUARANTEES

(a) All the bank guarantees towards security deposit & performance security shall have to be furnished from an Indian scheduled/nationalized bank on the Rajasthan State Non-judicial stamp paper of appropriate value (purchased in the name of guarantor/issuing bank) duly authenticated either by a first class Magistrate or Notary Public or directly confirmed by the issuing Bank towards Security/Performance security in favour of 'The MD, RSDCL, Jaipur'. All the Bank Guarantees shall be submitted to the purchaser.

(b) The bank guarantees should remain valid upto the last day of calendar month and be furnished in whole rupees.

(c) The contractor shall keep the Bid Bank Guarantee valid till the Performance Security submitted by him is accepted by the purchaser.

(d) Bank charges or any other charges, if any, shall be to the Contractor's account. If the Contractor fails to provide the Security within the period specified, such failure shall constitute a breach of the Contract and the COMPANY shall be entitled to make other arrangements at the risk and expenses of the Contractor and the earnest money deposited by the Contractor shall stand forfeited by the Company.

(e) All the bank guarantees towards security deposit & performance security shall be paid to COMPANY on first demand without any conditions or proofs.

(f) The Bank Guarantees shall be furnished by the bidder/ contractor, after checking the same correctly as per the check list.

40.0 CONTRACT PERFORMANCE GUARANTEE

40.1 As a contract performance security, the successful bidder, to whom the work is awarded, shall be required to furnish within a period of 15 (fifteen) days from the date of issue of
40.2 The Performance Guarantee shall cover additionally the following guarantees to the Owner:

(a) The successful bidder guarantees for successful and satisfactory operation of the equipment supplied and erected under the contract as per the specifications and documents.

(b) The successful bidder further guarantees that the equipment provided and installed by him shall be free from all defects in design, material and workmanship and shall upon written notice from the owner fully remedy free of expenses to the owner such defects as developed under the normal use of the said equipment within the period of guarantee specified in the relevant clause of the General Terms and Conditions in this Volume-I/ Special conditions of contract.

40.3 The contract performance guarantee is intended to secure the performance of the entire contract. However, it is not to be construed as limiting the damages under clause entitled “Equipment Performance Guarantee” in Technical Specifications, Volume-II and damages stipulated in other clauses in the Bid documents.

40.4 The performance guarantee will be returned to the contractor without any interest after expiry of guarantee period as indicated in clause 15 of GCC, after adjustment of recoveries, if any under the contract, unless the guarantee period is further extended as per clause 15 of GCC.

Note: The performance guarantee of some of equipments is more than 12 Months period and therefore, the contractor has either to extend the original performance bank guarantee for additional period or to furnish a separate performance bank guarantee against these equipments.

41.0 SECURITY GUARANTEE

In order to secure/assure due fulfillment of the contract, the successful bidder, to whom the contract is awarded shall be required to furnish within a period of 15 (Fifteen) days from the date of issue of the order(s) security bank guarantee equivalent to 2% (two percent) of the total contract value including prices of supply orders, erection, testing & commissioning charges and cost of Civil works & handholding charges in cash or by DD/ Baker's Cheque (no interest shall be payable on such deposits) or by way of Bank Guarantee from an Indian scheduled/nationalized bank, in the proforma attached at Annexure-I to this Volume-I in favour of the owner. The security bank guarantee shall remain valid for a period of 90 (ninety) days after handing over of all the sub-stations including civil works to RSDCL commissioned/completed in all respect and if required by the COMPANY, the validity of the Bank guarantee shall be extended, without any extra charges to COMPANY, for the period as desired.

Unless otherwise specifically required to be retained/forfeited by the COMPANY, the Security deposit shall be refunded/ returned on request of the Contractor after three months on completion of the entire work of lot and handing over after commissioning to the satisfaction of the COMPANY.
If the Contractor fails or neglects to observe or perform any of his obligation under the contract, it will be lawful for the COMPANY to forfeit either in whole or in part at his absolute discretion, the Security deposit in the form of BG/ Demand Draft furnished by the Contractor.

42.0 GENERAL

(a) The Contractor shall treat the details of the specification and other Bid documents as private and confidential and shall not reproduce without the written authorisation of the COMPANY.

(b) The COMPANY does not bind itself to accept the lowest or any bid or any part of the bid and shall not assign any reason(s) for the rejection of any Bid or a part thereof.

(c) The fact of submission of bid to the COMPANY shall be deemed to constitute an agreement between the Bidder and COMPANY whereby such Bid shall remain open for acceptance by the COMPANY and Bidder shall not have option to withdraw his offer, impair or derogate the same. If the Bidder is notified during the period of validity of Bid that his Bid is accepted by the COMPANY, he shall be bound by the terms of agreement constituted by his Bid and such acceptance thereof by the COMPANY, until formal contract of the same bid has been executed between him and the COMPANY in replacement of such agreement.

(d) The successful bidder shall have to execute the contract documents/agreement for the proper fulfillment of the contract. This shall be done by him and shall furnish such an executed stamped agreement free of charge.

(e) Type test charges if required, the same shall be considered as in built in the quoted prices.

(f) The bids shall be evaluated on the basis of package price of all the 4 Pooling Sub-stations including the cost of material, ETC, Civil works and charges of Handholding. The Transformersand Reactors losses as quoted by the bidders shall also be considered for price evaluation.
RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LIMITED

PART-II

GENERAL TERMS & CONDITIONS OF CONTRACT

(GCC)

FOR

CONSTRUCTION OF 4 NOS. 220/33KV PARK POOLING SUB-STATIONS

AT NOKH, JAISALMER (RAJ.)

No. RSDCL/D(T)/SP/Nokh/PPS/TK/ TN-03 (2019-20)
PART-II

SECTION - GCC

GENERAL TERMS & CONDITIONS OF CONTRACT

A. INTRODUCTION

1.0 DEFINITION OF TERMS

1.1 'The contract' means the agreement entered into between owner and contractor as per the contract agreement signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference there-in.

1.2 “Owner” or “Purchaser” or “Company” shall mean the RSDCL, JAIPUR, India and shall include their legal representatives, successors and assigns.

1.3 'Contractor' shall mean the bidder whose bid will be accepted by the owner for the award of the works and shall include such successful bidder’s legal representatives, successors and permitted assigns. ‘Supplier’ shall mean the equipment/material supplier or the Contractor himself.

1.4 'Sub-contractor' shall mean the person named in the contract for any part of the works or any person to whom any part of the contract has been sublet by the Contractor with the consent in writing of the Engineer and will include the legal representative, successors and permitted assigns of such person.

1.5 ‘Engineer’ shall mean the officer appointed in writing by the Owner/RSDCL to act as Engineer from time to time for the purposes of the contract.

1.6 ‘Consulting Engineer’/‘consultant’ shall mean any firm or person duly appointed as such from time to time by the owner.

1.7 The terms ‘Equipment’, ‘Stores’ and ‘Materials’ shall mean and include equipment, stores and materials to be provided by the contractor under the contract.

1.8 'Works' shall mean and include the furnishing of equipment, labour and services, as per the specifications and complete erection, testing and putting into satisfactory operation including all transportation, handling, unloading and storage at the site as defined in the contract.

1.9 ‘Specifications’ shall mean the specification and bidding document forming a part of the contract and such other schedules and drawings as may be mutually agreed upon.

1.10 'Site' shall mean and include the land and other places on, into or through which the works and the related facilities are to be erected or installed and any adjacent land, paths, street or reservoir which may be allocated or used by the owners or contractor in the performance of the contract.

1.11 The term 'Contract price' shall mean the lump sum price quoted by the contractor in his bid with additions and/or deletions as may be agreed and incorporated in the letter of Award, for the entire scope of the works.

1.12 The term 'Equipment Portion' of the contract price shall mean the ex-works value of the equipment.

1.13 The term 'Erection portion' of the contract price shall mean the value of field activities of the Works including erection, testing and putting into satisfactory operation including successful completion of performance and guarantee test to be performed at site by the contractor including cost of insurances.
1.14 ‘Manufacturer’s Works’ or ‘Contractor’s Works’ shall mean the place of work used by the manufacturer, the contractor, their collaborators/associate or sub-contractors for the performance of the contract.

1.15 ‘Inspector’ shall mean the owner or any person nominated by the owner from time to time, to inspect the equipment, stores or works under the contract and/or the duly authorised representative of the owner.

1.16 ‘Notice of Award of Contract/’Letter of Award’/‘Telex of award’ shall mean the official notice issued by the owner notifying the contractor that his bid has been accepted.

1.17 ‘Date of contract’ shall mean the date on which notice of award of contract/letter of Award has been issued.

1.18 ‘Month’ shall mean the calendar month. ‘Day’ or ‘days ‘unless herein otherwise expressly defined shall mean calendar day or days of 24 hours each. A ‘week’ shall mean continuous period of seven (7) days.

1.19 ‘Writing’ shall include any manuscript, type written or printed statement, under or over signature and/or seal as the case may be.

1.20 When the words ‘Approved’, ‘Subject to Approval’, ‘Satisfactory’, ‘Equal to’, ‘proper’, ‘requested’, ‘As directed’, ‘where directed’, ‘when directed’, ‘determined by’, ‘accepted’, ‘permitted’, or words and phrases of like importance are used the approval, judgement, direction etc. is understood to be a function of the RSDCL/Engineer.

1.21 Test on completion shall mean such tests as prescribed in the contract to be performed by the contractor before the work is taken over by the owner.

1.22 ‘Start up’ shall means the time period required to bring the equipment covered under the contract from an inactive condition, when construction is essentially complete, to the state ready for trial operation. The startup period shall include preliminary inspection and checkout of equipment and supporting sub-system, initial operation of the complete equipment covered under the contract to obtain necessary pre-trial operation data, perform calibration and corrective action, shut down, inspection and adjustment prior to the trial operation period.

1.23 ‘Initial operation’ shall mean the first integral operation of the complete equipment covered under the contract with the sub-system and supporting equipment in service or available for service.

1.24 ‘Trial operation’, Reliability test’, Trial run’, ‘Completion test’, shall mean the extended period of time after the start up period. During this trial operation period the unit shall be operated over the full load range. The length of trial operation shall be as determined by the Engineer, unless otherwise specified elsewhere in the contract.

1.25 ‘Performance and guarantee test’ shall mean all operational checks and tests required to determine and demonstrate capacity, efficiency and operating characteristics as specified in the contract documents.

1.26 The term ‘Final Acceptance/Taking over’ shall mean the owner’s written acceptance of the works performed under the contract, after successful commissioning/completion of performance and guarantee tests, as specified in the accompanying Technical specification or otherwise agreed in the contract.

1.27 ‘Commercial operation’ shall mean the conditions of operation in which the complete equipment covered under the contract is officially declared by the owner to be available for continuous operation at different loads up to and including rated capacity, such declaration by the owner, however, shall not relieve or prejudice the contractor of any of his obligations under the contract.
1.28 'Guarantee Period'/Maintenance period' shall mean the period during which the contractor shall remain liable for repair or replacement of any defective part of the works performed under the contract.

1.29 'Latent Defects' shall mean such defects caused by faulty design, material or workmanship which cannot be detected during inspection, testing etc. based on the technology available for carrying out such tests.

1.30 'Drawings', 'Plans' shall mean all:

(a) Drawings furnished by the owner/consultant as a basis for bid/proposals.
(b) Supplementary drawings furnished by the owner/consultant to clarify and to define in greater detail the intent of the contract.
(c) Drawings submitted by the contractor with his bid provided such drawings are acceptable to the owner/consultant.
(d) Drawings furnished by the owner/consultant to the contractor during the progress of the work.
(e) Engineering data and drawings submitted by the contractor during the progress of the work provided such drawings are acceptable to the Engineer/owner.

1.31 'Codes' shall mean the following, including the latest amendments, and/or replacements if any:

(a) Indian Electricity Act-2003 and Rules and Regulations made there under.
(b) Indian Factory Act-1948, and rules and regulations made there under.
(c) Indian Explosive Act-1884, and rules and regulations made there under.
(d) Indian Petroleum Act-1934, and rules and regulations made there under.
(e) A.S.M.E. Test codes.
(f) A.I.E.E. Test codes.
(g) American Society of Materials Testing codes.
(h) Standards of the Indian Standards Institution.
(i) Other Internationally approved standards and or rules and regulations touching the subject-matter of the contract.

1.32 Words imparting the singular only shall also include the plural and vice-versa where the context so requires.

1.33 Words imparting 'person' shall include firms, companies, corporation and associations or bodies of individuals, whether incorporated or not.

1.34 Terms and expressions not herein defined shall have the same meanings as are assigned to them in the Indian Sales of Goods Act(1930), falling that in the Indian Contract Act(1872) and falling that in the General clauses Act (1897) including amendments thereof if any.

The various Acts and Regulations are normally available for sale from the following addresses:

(i) Deputy Controller, Publication Department, Government of India, Civil Lines, Delhi-06.
(ii) Deptt. of Publication (Government of India), Kitab Mahal, Unit No.21, Emporia Building, Baba Kharak Singh Marg, NEW DELHI-110001.

Or

With leading authorized Government of India Book sellers.

1.35 In addition to above, the following definitions shall also apply:

(a) 'All equipment and materials' to be supplied shall also mean 'Goods'.
(b) 'Constructed' shall also mean 'erected and installed'
(c) 'Contract Performance Guarantee' shall also mean 'Contract Performance Security'.

2.0 APPLICATION

These General conditions shall apply to the extent that they are not superseded by provisions in other parts of the contract.
3.0 **STANDARDS**

The goods supplied under this Contract shall conform to the standards mentioned in the Technical Specification and when no applicable standard is mentioned to the authoritative standard appropriate to the good and such standards shall be the latest issued by the concerned institution.

4.0 **LANGUAGE AND MEASURES**

All documents pertaining to the contract including specification, schedules, notices, correspondence, operating and maintenance instructions, drawings or any other writing shall be written in English language. The Metric system of measurement shall be used exclusively in the contract.

5.0 **CONTRACT DOCUMENTS**

5.1 The term contract documents shall mean and include the following which shall be deemed to form an integral part of the contract.

(a) Invitation of Bid including letter forwarding the bidding documents, instructions to bidders, general terms and conditions of contract, erection conditions of contract and all other documents included under Volume I and the special conditions of contract.

(b) Contract agreement duly executed in proformaat Annexure-V(A) & V(B), Volume-I.

(c) Specifications of the equipment to be furnished and erected under the contract and specification of erection testing commissioning as brought out in the accompanying Technical specifications (Vol.-II) and specification of Civil works (Vol.-III).

(d) Contractor’s bid proposal and the documents attached thereto including the letters of clarifications thereto between the contractor and the owner/consultant prior to the Award of Contract except to the extent of repugnancy.

(e) All the materials, literature, data and information of any sort given by the contractor along with his bid, subject to the approval of the owner/consultant.

(f) Letter of Award, detailed POs, work orders and any agreed variations of the conditions of the documents and special terms and conditions of contract, if any.

5.2 In the event of any conflict between the above mentioned documents, the matter shall be referred to the Director (Tech) RSDCL, Jaipur whose decision shall be considered as final and binding on the parties.

6.0 **USE OF CONTRACT DOCUMENTS AND INFORMATION**

6.1 The contractor shall not, without the Owner’s prior written consent, disclose the contract, or any provision thereof, or any specification, plan, drawing, pattern, sample or information furnished by or on behalf of the owner in connection therewith, to any person other than a person employed by the contractor in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.

6.2 The contractor shall not, without the owner’s prior written consent, make use of any document or information enumerated in various contract documents except for purpose of performing the contract.

6.3 The contractor shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs or other reproduction of the works under this contract, or descriptions of the site, dimensions, quantity, quality or other information, concerning the works unless prior written permission has been obtained from RSDCL.
6.4 Any document, other than the contract itself, enumerated in various contract documents shall remain the property of RSDCL and shall be returned (in all copies) to the owner on completion of the contractor's performance under the contract, if so required by the owner.

7.0 **CONSTRUCTION OF THE CONTRACT**

7.1 Notwithstanding anything stated elsewhere in the bid documents, the contract to be entered into will be treated as a divisible supply and erection contract. The supply portion of the contract will relate to the supply of equipment & materials and the erection portion will relate to the handling at the site, storage, erection, construction, testing, commissioning and execution of Civil works & handholding of Poolingsub-stations etc. as defined in the bid documents. The owner will pay the applicable GST & other taxes, if any for the supply of equipment and materials in accordance with prevailing laws.

7.2 The contract shall in all respects be construed and governed according to Indian laws.

7.3 It is clearly understood that the total consideration for the Contract has been broken up into various components only for the convenience of payment of advance under the contract and for the measurement of deviations or modifications under the contract.

8.0 **JURISDICTION OF CONTRACT**

8.1 The laws applicable to the Contract shall be the laws in force in India. The courts of JAIPUR shall have exclusive jurisdiction in all matters arising under this contract.

9.0 **MANNER OF EXECUTION OF CONTRACT**

9.1 The Contractor shall have to execute the contract documents within a period of 15 days from the date of issue of Letter of Award (LOA), in prescribed form (copy enclosed) on Rajasthan State Non-judicial stamp paper of appropriate value as per stamp duty applicable in Govt. of Rajasthan along with copy of the order, copy of General Conditions of Contract, Special Conditions of Contract including Erection & Civil, Technical specification etc. It is advised that each and every page of relevant documents is to be signed by authorized person. It may however be ensured that one copy of the order and other documents as above, are signed by an authorized person holding valid power of attorney and returned to the Director (Tech), RSDCL, Jaipur. The power of attorney on non-judicial stamp paper worth Rs. 100/- (attested by the Notary Public) in favour of person signing these documents, duly notarized in original be also submitted along with the above documents.

9.2 The Contract Agreement (CA), unless otherwise agreed to, shall be signed within 15 (Fifteen) days of the issue of the Letter of Award, at the office of RSDCL i.e. RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LTD, E-166 YudhishthirMarg, C-Scheme, Jaipur on a date and time to be mutually agreed. The contractor shall provide for signing of the Contract Agreement in the specified period. In case, the contract is to be signed beyond the stipulated time, the period for return of Bid security submitted with the proposal will automatically be extended accordingly. The receipt of above documents and the same being in order shall be notified by the Director (Fin), RSDCL, Jaipur in due course of time under intimation to the Director (Tech), RSDCL, Jaipur. No any payment shall be released without acceptance of the Contract Agreement, Performance Bank Guarantee (PBG), Security Bank Guarantee (SBG)and approval of Project Implementation Schedule (L-2 Network).

9.3 The agreement will be signed in Two originals and the Contractor shall be provided with one signed original and the rest one will be retained by the owner.

9.4 The Contractor shall provide free of cost to the owner all the engineering data, drawings and descriptive materials submitted with the bid to form a part of the contract immediately after issue of letter of award.
9.5 (a) Within thirty (30) days of the date of receipt of the RSDCL's letter of intent, the Contractor shall submit all the drawings and guaranteed & other technical particulars to the purchaser for approval.

(b) RSDCL shall return to the Contractor one (1) set of all these drawings, after marking them with their comments/corrections if any, either (a) stamped approved or (b) marked up with the comments. In case of (a), no further submission of drawings will be required. In case of (b), the Contractor shall correct his original drawings and will be required to conform to the comments made and resubmit within two (2) weeks of receipt of comments in the same manner as stated in the distribution schedule. The approval shall not relieve the Contractor from any of his obligations and responsibility to fabricate and erect the materials conforming to the specifications unless a written amendment to the specification is issued by the purchaser. After approval of the drawings, a reproducible of each drawing shall be supplied & the final drawings shall be certified as "Approved for Construction".

(c) Should any minor revision be made after "Approval", the Contractor shall redistribute prints and reproducible as per the distribution schedule. Every revision shall be marked by a number, date and subject in a revision block provided in the drawings.

(d) Reproducible shall be of quality to produce clear and legible prints and any inferior reproducible will be returned by the purchaser for replacement with suitable reproducible. All reproducible shall be mailed rolled (not folded) on the outside of regular mailing tubes except for small sizes which can be mailed unfold in an envelope with a card board backing. The prints and reproducible shall be mailed in the most expeditious manner and shall be accompanied with a letter of transmittal.

(e) The item for which we have enclosed our standard drawings, no contract drawings shall be required and the contractor shall be required to supply the material as per our standard tender drawings. Otherwise, the bidder shall develop the drawings as per requirement & norms and submit the same (in 3 copies) for approval to RSDCL.

10.0 ENFORCEMENT OF TERM

10.1 The failure of either party to enforce at any time any of the provisions of this contract or any rights in respect thereto or to exercise any option therein provided shall in no way be construed to be a waiver of such provisions, rights or options or in any way to affect the validity of the contract. The exercise by either party of any of its rights herein shall not preclude or prejudice either party from exercising the same or any other right it may have under the contract.

11.0 COMPLETION OF CONTRACT

11.1 Unless otherwise terminated under the provisions of any other relevant clause, this contract shall be deemed to have been completed on the expiry of the guarantee period as provided for under the clause entitled ‘Guarantee’ in this Section of the Volume-I.

B. GUARANTEES AND LIABILITIES

12.0 TIME -THE ESSENCE OF CONTRACT

12.1 The time and the date of completion of the contract as stipulated in the contract by the RSDCL without or with modifications, if any and so incorporated in the letter of Award, shall be deemed to be the essence of the Contract. The contractor shall so organize his resources and perform his work as to complete it not later than the date agreed to.

12.2 The contractor shall submit a detailed L-2 network within the time frame agreed consisting of adequate number of activities covering various key phases of the work such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days from the date of acknowledgement of LOA. This network shall also indicate the interface facilities to be provided by the owner and the dates by which such facilities are needed. The contractor shall discuss the network so submitted with the owner and the agreed
network shall form part of the contract documents. As provided in the clause of Terms of payment in this section, finalization of the L-2 network will be precondition for release of any advance to the contractor. During the performance of the contract, if in the opinion of RSDCL, proper progress is not maintained; suitable changes shall be made in the contractor's operations to ensure proper progress without any cost implication to the owner. The interface facilities to be provided by the owner in accordance with the agreed network shall also be reviewed while reviewing the progress of the contractor.

12.3 Based on the above agreed L-2 network, fortnightly reports shall be submitted by the Contractor as directed by the Nodal officer/Engineer In-charge.

12.4 Subsequent to the finalization of the network, the contractor shall make available to the Engineer a detailed manufacturing programme, in line with the agreed contract network & such manufacturing programme shall be reviewed, updated and submitted to the Engineer once every two months thereafter.

12.5 The above L-2 network/manufacturing programme shall be compatible with the Owner’s computer environment and furnished to the Owner on such media as may be desired by the Owner.

13.0 EFFECTIVENESS OF CONTRACT

The contract shall be considered as having come into force from the date of the Notification of Award unless otherwise provided in the Notification of Award.

14.0 DELAY IN DELIVERY/ COMPLETION

14.1 The time and the date of delivery/completion period specified in the purchase/work order shall be deemed to be the essence of the contract and the works of all park Pooling Sub-stations shall have to be completed not later than the period specified in the specification or any extension thereof. Should the contractor fail to complete the work (including testing and commissioning and civil works) of the Pooling Sub-stations on order or any part thereof within the specified completion period, the contractor shall pay recovery to the owner towards delay in completion of Pooling Sub-stations, a sum equivalent to half percent (0.5%) of the total contract price (material, erection & Civil works including handholding charges) as a recovery for such default, for each week or part thereof of delay, until actual completion, up to a maximum recovery of 10% of the total contract price (material, erection & Civil works including handholding charges). The payment or deduction of such recovery shall not relieve the contractor from its obligation to complete the works or any other obligations and liabilities under the contract.

14.2 Any financial liability arising from and consequent upon the failure of the contractor to adhere to the stipulated completion schedule shall be to the contractor's account.

Note: ‘Contract price’ shall mean “Ex-works price of material/equipments including all taxes & duties and total cost of erection, testing, commissioning & Civil works and handholding charges of Pooling Sub-stations”.

14.3 Equipment and materials will be deemed to have been delivered only when all its components, parts are also delivered. If certain components are not delivered in time, the equipment and materials will be considered as delayed until such time the missing parts are also delivered.

14.4 The recovery for not meeting the performance guarantees during the performance and guarantee test shall be assessed and recovered from the contractor as detailed in SCC and technical specification. Such recoveries shall be without any limitation whatsoever and shall be in addition to recoveries, if any payable under any other clause of conditions of contract.

14.5 The recovery for delay in completion of works shall be applicable for complete contracts (Supply of material & equipments & erection testing & commissioning part and execution of
civil works & handholding of Pooling Sub-stations part) and all these recoveries will run concurrently.

14.6 RSDCL may without prejudice to any other method of recovery, deduct the amount of such recovery from any of dues or to become due to the Contractor including final 10% payment (retention money).

15.0 GUARANTEE FOR POOLING SUB-STATIONS WORK:

15.1 The contractor shall guarantee that all the equipment/material will be new, unused and in accordance with the contract documents & relevant ISS and free from defects in material and workmanship for a period of twelve (12) calendar months (Except the guarantee of individual equipment mentioned in the specification of that equipment) commencing immediately upon the handing over of the Pooling Sub-stations including Civil works to RSDCL by the contractor, after satisfactory commissioning of all equipments, completion of Pooling-Sub-stations including Civil works in all respect.

The contractor’s liability shall be limited to the replacement of any defective parts in the equipment of his own manufacture or those of his sub-contractors, under normal use and arising solely from faulty design, materials and/or workmanship provided always that such defective parts are repairable at the site and are not in meantime essential in the commercial use of the equipment. Such replaced/defective parts shall be returned to the Contractor unless otherwise arranged. No repairs or replacement shall normally be carried out by the Engineer when the equipment is under the supervision of the Contractor’s supervisory Engineer.

15.2 In the event of any emergency where in the judgment of the Engineer, delay would cause serious loss to RSDCL or damages to the owner’s equipments/works, repairs or adjustments may be made by the RSDCL Engineer or a third party chosen by the Engineer without advance notice to the contractor and the cost of such work shall be paid by the contractor to the owner. In the event such action is taken by the Engineer, the contractor will be notified promptly and he shall assist wherever possible in making necessary corrections. This shall not relieve the contractor of his liabilities under the terms and conditions of the contract.

15.3 If it becomes necessary for the contractor to replace or renew any defective portions of the equipments/works, the provision of this clause shall apply to portion of the works/items so replaced or renewed until the expiry of twelve (12) months from the date of such replacement or renewal for all equipments/items. If any defect is not remedied within a reasonable time, the RSDCL may proceed to do the work at the contractor’s risk and cost, but without prejudice to any other rights which the owner may have against the contractor in respect of such defects.

15.4 The repaired or new parts will be furnished and erected free of cost by the contractor. If any repair is carried out on his behalf at the site, the contractor shall bear the cost of such repairs.

15.5 The cost of any special or general overhaul rendered necessary during the maintenance period due to defects in the equipment or defective works carried out by the contractor, the same shall be borne by the contractor.

15.6 The acceptance of the equipment by the Engineer shall in no way relieve the contractor of his obligations under this clause.

15.7 In the case of those defective parts which are not repairable at site but are essential for the commercial operation of the equipment, the contractor and the Engineer In-charge of RSDCL shall mutually agree to a programme of replacement or renewal which will minimise interruption to the maximum extent, in the operation of the equipment.

15.8 At the end of the Guarantee Period (as per Clause No. 15.1 above), the contractor’s liability ceases except for latent defects. For latent defects, the contractor’s liability as mentioned in Clause No.15.1 through 15.7 above, shall remain till the end of 5 years from the date of
completion of Guarantee period. In respect of goods supplied by sub-contractors to the contractor where a longer guarantee (more than 12 months) is provided by such sub-contractor, the owner shall be entitled to get benefit of such longer guarantee.

15.9 MAINTENANCE AND GUARANTEE FOR WORKS:

15.9.1 MAINTENANCE:

(a) For a period of 12 (twelve) calendar months commencing immediately upon the setting to work of the plant, the Contractor's liability shall be limited to the replacement of any defective part that may develop in plant of his own manufacture or those of his sub-Contractor's approved under clause & under the conditions provided for by defective parts/ portions that the Contract under proper use and arising solely from faulty design materials, or workmanship provided always that such defective parts as are not repairable at site, are promptly returned to the Contractor at his cost unless otherwise arranged. If it becomes necessary for Contractor to replace or renew any defective portions of the plant under this clause, the provisions of this clause shall apply to the portions of the plant so replaced or renewed until the expiration of six months, from the date of such replacement or renewal until the end of the above mentioned period of twelve months after commissioning, whichever may be the later, if any defect be not remedied within a reasonable time, the purchaser may proceed to do the work at the Contractor's risk and expense, but without prejudice to any other rights which the purchaser may have against the Contractor in respect of such defects.

(b) The repaired or new parts will be delivered F.O.R. unless otherwise agreed. The Contractor shall bear reasonable cost of minor repairs carried out on his behalf at site. Should the Contractor has to send a representative to site to carry out repairs, the purchaser shall bear the cost of the voyage out and home.

(c) The Engineer shall be at liberty to object to any representative or persons(s) employed by the Contractor in the execution of or otherwise above the work who shall misconduct himself or be incompetent or negligent.

(d) At the end of the maintenance period, the Contractor's liability ceases in respect of goods not covered by the first paragraph of this clause, the purchaser shall be entitled to the benefit of any guarantee to the Contractor by the original supplier or manufacturer of such goods.

15.9.2 MAINTENANCE AND DEFECTS:

(a) In these conditions the expression "Period of Maintenance" shall mean the period of maintenance calculated from the date of completion of the work, certified by the Engineer in accordance with clause Nos. 61 and 62 below, or in the event of more than one certificate having been issued by the Engineer under the said clauses, from the respective dates so certified and in relation to the period of Maintenance the expiration "the works" shall be construed accordingly.

(b) To the intent that the works shall at or as soon as practicable after the expiration of the period of Maintenance be delivered to the owner in the condition required by the contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall finish the work, if any, outstanding at the date of completion, as certified under clause Nos. 61 and 62 below, as soon as practicable after such date and shall execute all such work of repair, amendment, reconstruction, rectification and making good defects, imperfections, shrinkages or other faults as may be required of the Contractor in writing by the Engineer during the period of Maintenance, or within fourteen days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration.

(c) All such works shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer, be due to the use of materials or workmanship not in accordance with the contract or to neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the
contract. If, in the opinion of the Engineer, such necessity shall be due to any other cause, the value of such work shall be ascertained and paid for as if it were additional work.

(d) If the Contractor fails to do any such work as aforesaid required by the Engineer, the Employer shall be entitled to employ and pay other persons to carry out the same and if such work which, in the opinion of the Engineer, the Contractor was liable to do at his own expense under the contract, then all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Employer, or may be deducted by the Employer from any money due or which may become due to the Contractor.

(e) The Contractor shall, if required by the Engineer in writing, search under the directions of the Engineer for the cause of any defect, imperfection or fault appearing during the progress of the works or in the period of Maintenance. Unless such defect, imperfection or fault shall be one for which the Contractor is liable under the contract, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case repair, rectify and make good such defect, imperfection or fault at his own expense in accordance with the provisions of clause No.15.10.1 above.

15.9.3 MAINTENANCE CERTIFICATE:

(a) No certificate other than the Maintenance certificate referred to in clause No. 15.9.2 thereof shall be deemed to constitute approval of the works.

(b) The contract shall not be considered as completed until a Maintenance certificate shall have been signed by the Engineer and delivered to the Contractor stating that the works have been completed and maintained to the satisfaction of the Engineer. The Maintenance certificate which shall be given by the Engineer shall be given within twenty eight days after the expiry of the period of maintenance, or if different periods of maintenance shall become applicable to different sections or parts of the works, the expiration of the latest such period pursuant to sub-clauses of 63 below, shall have been completed to the satisfaction of the Engineer and full effect shall be given to this clause, notwithstanding any previous entry on the works or taking possession of, working or using thereof or any part thereof by the Employer, provided always that the issue of a maintenance certificate shall not be a condition precedent to payment to the Contractor of the balance payment in accordance with the conditions set out in clause No.34 below.

(c) The employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the contract or the execution of the works, unless the Contractor shall have made a claim in writing in respect thereof before giving the Maintenance Certificate under this clause.

(d) Notwithstanding the issue of the maintenance certificate to the Contractor, and subject to clause No. 15.10.2(c) the owner shall remain liable for the fulfillment of any obligation incurred under the provisions of the contract prior to the issue of the Maintenance certificate which remains unperformed at the time such certificate is issued and, for the purpose of determining the nature and extent of any such obligation, the contract shall be deemed to remain in force between the parties hereto.

16.0 TAXES, PERMITS AND LICENCES

The Contractor shall be liable and pay all non-Indian & Indian taxes, duties, levies, lawfully assessed against the Owner or the Contractor in pursuance of the Contract. In addition, the Contractor shall be responsible for payment of all Indian duties, levies and taxes lawfully assessed against the contractor for his personal income and property. This clause shall be read in conjunction with Clause 15.0 of Section ITB of this Volume I.

The Contractor shall ensure the compliance in respect to E-way bill provisions as notified under Rule 138 of CGST Rules and corresponding State GST Rules. RSDCL shall not be responsible incase of any non-compliance by the supplier/contractor.
17. REPLACEMENT OF DEFECTIVE PARTS AND MATERIALS

17.1 If during the performance of the Contract, the Engineer shall decide and inform in writing to the contractor that the contractor has manufactured any equipment, material or part of equipment unsound and imperfect or has furnished any equipment inferior to the quality specified, the Contractor on receiving details of such defects or deficiencies shall at his own expense make it good, proceed to alter, reconstruct or remove such works and furnish fresh equipment/materials up to the standards of the specifications within 15 days of receipt of notice from RSDCL. In case the contractor fails to do so within 15 days of receipt of notice, the Engineer may on giving the contractor seven (7) days notice in writing of his intentions to do so, proceed to remove the portion of the Works so complained and at the cost of the contractor perform all such work or furnish all such equipment/material provided that nothing in this clause shall be deemed to deprive the owner or affect any rights under the contract which the owner may otherwise have in respect of such defects and deficiencies.

17.2 The contractor's full and extreme liability under this clause shall be satisfied by the payment to the owner of the extra cost, of such replacement procured including erection as provided for in the Contract, such extra cost being the ascertained difference between the price paid by the owner for such replacements and the contract price by portion for such defective equipment/materials/works and repayments of any sum paid by the owner to the contractor in respect of such defective equipment/material. Should the owner not so replace the defective equipment/materials the contractor's extreme liability under this clause shall be limited to repayment of all sums paid by the owner under the contract for such defective equipment/materials.

18.0 PATENT RIGHTS AND ROYALTIES

Royalties and fees for patents covering materials, articles, apparatus, devices, equipment or processes used in the works shall be deemed to have been included in the Contract Price. The Contractor shall satisfy all demands that may be made at any time for such royalties or fees and he alone shall be liable for any damages or claims for patent infringements and shall keep the Owner indemnified in that regard. The Contractor shall, at his own cost and expense, defend all suits or proceedings that may be instituted for alleged infringement of any patents involved in the works, and, in case of an award of damages, the contractor shall pay for such award. In the event of any suit or other proceedings instituted against the owner, the same shall be defended at the cost and expense of the contractor who shall also satisfy/comply with any decree, order or award made against the owner. But it shall be understood that no such machine, plant, work, material or thing has been used by the owner for any purpose or in any manner other than that for which they have been furnished and installed by the contractor and specified under these specifications. Final payment to the Contractor by the Owner will not be made while any such suit or claim remains unsettled. In the event any apparatus or equipment, or any part thereof furnished by the Contractor, is in such suit or proceedings held to constitute infringement, and its use is enjoined, the contractor shall at his option and at his own expense, either procure for the owner, the right to continue the use of said apparatus, equipments, or part thereof, replace it with non-infringing apparatus or equipment or modify it, so it becomes non-infringing.

19.0 DEFENCE OF SUITS

If any action in Court is brought against the owner or Engineer or an officer or agent of the owner, for the failure, omission or neglect on the part of the Contractor to perform any acts, matters, covenants or things under the contract, or for damage or injury caused by the alleged omission or negligence on the part of the contractor, his agents, representatives or his Sub-Contractors, or in connection with any claim based on lawful demands of subcontractors, workman, suppliers or employees, the contractor shall in all such cases indemnify and keep the owner, and the Engineer and/or his representative, harmless from all losses, damages, expenses or decrees arising of such action.
20.0 LIMITATION OF LIABILITIES

The final payment by the owner in pursuance of the contract shall mean the release of the Contractor from all his liabilities under the contract. Such final payment shall be made only at the end of the Guarantee/Warranty period, and till such time as the contractual liabilities and responsibilities of the contractor, shall prevail. All other payments made under the contract shall be treated as on-account payments.

21.0 ENGINEER'S DECISION

21.1 In respect of all matters which are left to the decision of the Engineer including the granting or with loading of the certificates, the Engineer shall, if required to do so by the Contractor, give in writing a decision thereon.

21.2 If, in the opinion of the contractor, a decision made by the Engineer is not in accordance with the meaning and intent of the Contract the Contractor may file with the Engineer, within fifteen (15) days after receipt of the decision, a written objection to the decision. Failure to file an objection within the allotted time will be considered as an acceptance of the Engineer's decision and decision shall become final and binding.

21.3 The Engineer's decision and the filing of the written objection thereto shall be a condition precedent to the right to request to the settlement committee (Shall be formed by RSDCL). It is the intent of the Agreement that there shall be no delay in the execution of the works and the decision of the Engineer as rendered shall be promptly observed.

22.0 POWER TO VARY OR OMIT WORK

22.1 No alterations, amendments, omissions, suspensions or variations of the works (hereinafter referred to as 'variation') under the contract as detailed in the contract documents, shall be made by the contractor except as directed in writing by the Engineer, but the Engineer shall have full powers subject to the provisions hereinafter contained, from time to time during the execution of the contract, by notice in writing to instruct the contractor to make such variation without prejudice to the contract. The contractor shall carry out such variation and be bound by the same conditions as far as applicable as though, the said variations occurred in the contract documents. If any suggested variations would, in the opinion of the contractor, if carried out, prevent him from fulfilling any of his obligations or guarantees under the contract, he shall notify the Engineer thereof in writing and the Engineer shall decide forthwith whether or not, the same shall be carried out and if the Engineer confirms his instructions, the contractor's obligations and guarantees shall be modified to such an extent as may be mutually agreed. Any agreed difference in cost occasioned by any such variation shall be added to or deducted from the contract price as the case may be.

22.2 In the event of Engineer requiring any variation, a reasonable and proper notice shall be given to the contractor to enable him to work his arrangement accordingly, and in cases where goods or materials are already prepared or any design, drawings or pattern made or work done requires to be altered, a reasonable and agreed sum in respect thereof shall be paid to the contractor.

22.3 In any case in which the contractor has received instructions from the Engineer as to the requirement of carrying out the alterations or additional or substituted work which either then or later on, will in the opinion of the contractor, involve a claim for additional payment, the contractor shall immediately and in no case later than thirty (30) days, after receipt of the instructions aforesaid and before carrying out the instructions, advise the Engineer to that effect. But the Engineer shall not become liable for the payment of any charges in respect of any such variations, unless the instructions for the performance of the same shall be confirmed in writing by the Engineer.

22.4 If any variation in the works results in reduction of contract price, the parties shall agree, in writing, so to the extent of any change in the price, before the contractor proceeds with the change.
22.5 In all the above cases, in the event of a disagreement as to the reasonableness of the said sum, the decision of the Engineer shall prevail.

22.6 Notwithstanding anything stated above in this clause, the Engineer shall have the full power to instruct the contractor, in writing during the execution of the contract to vary the quantities of the items or groups of items in accordance with the provisions of clause entitled 'Change of quantity' in Section GCC of this Volume-I. The Contractor shall carry out such variations and be bound by the same conditions as though the said variations occurred in the contract documents. However, the contract price shall be adjusted at the rates and the prices provided for the original quantities in the Contract.

23.0 ASSIGNMENT AND SUB-LETTING OF CONTRACT

23.1 The contractor may, after informing the owner and getting his written approval, assign or sublet the contract for erection work and/or civil work of Pooling Sub-stations or any part thereof. The experience list of such sub contractors for erection/civil works under consideration by the contractor for this contract shall be furnished to the owner for approval within 15 days from the date of issue of detail award prior to commencement of erection/civil work. Such assignment/sub-letting shall not relieve the contractor of any obligation, duty or responsibility under the contract. Any assignment as above, without prior written approval of Engineer, shall be void.

24.0 CHANGE OF QUANTITY:

FOR POOLING SUB-STATION:

24.1 During the execution of the contract, the owner reserves the right to increase or decrease the quantities of items under contract but without any change in unit price or other terms and conditions. Such variations unless otherwise specified in the accompanying, special conditions of contract and/or Technical specifications, shall not be subjected to any limitations for the individual items.

24.2 The contract price shall accordingly be adjusted based on the unit rates available in the contract for the change in quantities as above. The unit rates, as identified in the contract shall however remain constant during the currency of the contract. In case, the unit rate is not available for the change in quantity, the same shall be subject to mutual agreement.

24.3 Extra/Additional civil works, if any shall be carried out by the bidders as per provisions of technical specification Volume-III.

25.0 PACKING, FORWARDING AND SHIPMENT

25.1 (i) Unless otherwise mutually agreed upon, the material/equipment on order shall be required to be dispatched by road transport on 'Freight Paid' basis. However, this being a turnkey contract, the whole responsibility to take delivery of material at site shall be on the part of contractor.

(ii) The entire responsibility for freight of goods/material right from the manufacturer’s premises/RSDCL’s store house to work site shall be of the Contractor and he shall make and complete all necessary formalities as well as arrangements for the same.

25.2 The contractor shall notify the owner of the date of each shipment from his works and the expected date of arrival at the site for the information of the owner.

25.3 The contractor shall also give all shipping information concerning the weight, size and content of each packing including any other information the owner may require.

25.4 The following documents shall be sent by registered post to the RSDCL within 7 days from the date of shipment, to enable the owner to make progressive payments to the contractor:
(i) Application for payment along with two copies (original plus one copy) of invoice, with receipted challan, inspection/dispatch clearance certificate, packing list, insurance certificate & other dispatch documents to the Director (Fin.), RSDCL, Jaipur.

(ii) Copy of application form for payment along with copy of invoice, packing list, dispatch document i.e. LR, dispatch clearance, test certificate to the site Engineer Incharge.

(iii) Copy of application form for payment along with copy of invoice, receipted challan, dispatch clearance, insurance certificate, packing list & copy of other dispatch documents to the Director (Tech.), RSDCL, Jaipur.

25.5 The contractor shall prepare detailed packing list of all packages and containers bundles and loose material forming each and every consignment dispatched to site. The contractor shall further be responsible for making all necessary arrangements for loading, unloading and other handling right from his works to the site and also till the equipment is erected, tested and commissioned. He shall be solely responsible for proper storage and safe custody of all equipment.

25.6 The entire responsibilities for freight of goods/material right from the manufacturer's premises to work site shall be of the contractor and he shall make and complete all necessary formalities as well as arrangements for the same for this is total turnkey contract.

26.0 COOPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS:

The contractor shall agree to cooperate with the owner's other contractors and consulting Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Engineer shall be provided with three copies of all correspondence addressed by the contractor to other contractors and consulting engineers of the owner in respect of such exchange of technical information.

27.0 NO WAIVER OF RIGHTS

Neither the inspection by the owner or the Engineer or any of their officials, employees, or agents nor any order by the owner or the Engineer for payment of money or any payment for or acceptance of, the whole or any part of the works by the owner or the Engineer, nor any extension of time, nor any possession taken by the Engineer shall operate as a waiver of any provision of the contract, or of any power herein reserved to the owner or any right to damages herein provided nor shall any waiver of any breach in the contract be held to be a waiver of any other or subsequent breach.

28.0 CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF CONTRACTOR

No interim payment certificate of the Engineer, nor any sum paid on account by the owner, nor any extension of time for execution of the works granted by the engineer shall affect or prejudice the rights of the owner against the contractor or relieve the contractor of his obligation for the due performance of the contract, or be interpreted as approval of the works done or of the equipment furnished and no certificate shall create liability for the owner to pay for alterations, amendments, variations or additional works not ordered, in writing, by the Engineer or discharge the liability of the contractor for the payment of damages whether due, ascertained, or certified or not or any sum against the payment of which he is bound to indemnify the owner, nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect or prejudice the rights of owner against the contractor.

29.0 TRAINING OF OWNER’S PERSONNEL

29.1 If desired by RSDCL, the contractor shall undertake to train free of cost, engineering personnel selected and sent by the owner at the works of the contractor unless otherwise specified in the Technical Specifications. The period and the nature of training for the individual personnel shall be agreed upon mutually between the contractor and the owner.
These engineering personnel shall be given special training in the shops, where the equipment will be manufactured and/or in their collaborator’s works and where possible, in any other plant where equipment manufactured by the contractor or his collaborator is under installation, operation, or testing to enable those personnel to become familiar with the equipment being furnished by the contractor. The details of the Nos. of persons to be trained, period of training, nature of training etc. shall be as mutually agreed.

29.2 All travelling and living expenses for the engineering personnel to be trained during the total period of training will be borne by the owner. These engineering personnel, while undergoing training, shall be responsible to the contractor for discipline.

29.3 The owner shall not be entitled for any rebate whatsoever on any account in the event of his failing to avail of the training facilities, for any reason.

29.4 Immediately after the handing over of the sub-station, the successful bidder shall place his at least 3 (three) Nos. expert Engineers at each Pooling Sub-station for 12 months who can handle the initial operational problems and shall run the Sub-stations along with the RSDCL Engineers.

30.0 PROGRESS REPORTS AND PHOTOGRAPHS

30.1 During the various stages of the work in pursuance of the contract, the contractor shall at his own cost submit periodic progress reports as may be reasonably required by the Engineer with such materials as charts, net-works, photographs, test certificates, etc. Such progress reports shall be in the form and size as may be required by the engineer and shall be submitted in at least three (3) copies.

31.0 TAKING OVER OF POOLING SUB-STATIONS:

Upon successful completion of all the tests to be performed at site on equipments supplied and erected by the contractor and on completion of all the works of the Pooling sub-stations as per the specification, the engineer shall issue to the contractor, a taking over certificate as a proof of the final acceptance of the equipment. Similarly, on completion of building and other civil works of the Pooling Sub-stations as per specification, its taking over certificate shall be issued by the Director (Tech) in consultation with the civil Engineer of RSDCL or any authorized officer. Such certificate shall not unreasonably be withheld nor will the engineer delay the issuance thereof on account of minor omissions or defect which do not affect the commercial operation and/or cause any serious risk to the equipment/works. Such certificate shall not relieve the contractor of any of his obligations which otherwise survive, by the terms and conditions of the contract after issue of such certificate. The taking over certificate shall be issued by concerned Engineer and shall be counter signed by Director (Tech) RSDCL.

C. CONTRACT SECURITY AND PAYMENTS

32.0 CONTRACT PERFORMANCE GUARANTEE

The contractor shall furnish contract performance guarantee (s) for the proper fulfillment of the contract in the prescribed form within fifteen (15) days “from the date of issue of detailed purchase order(s)”. The performance guarantee (s) shall be as per terms prescribed in section ITB, Conditions of Contract Vol.-I and/or special conditions of contract.

33.0 CONTRACT PRICE & ESCALATION/VARIATION IN THE PRICE

33.1 No price escalation/variation shall be allowed as the bidders have to quote “FIRM” prices independent of any variation for all the materials and works.

34.0 PAYMENT

34.1 The payment to the contractor for the performance of the works under the contract will be made by the RSDCL as per the guidelines and conditions specified herein. All payment made
during the contract shall be on account payments only. The firm/contractor shall raise/issue Tax invoices in accordance with CGST Act, 2017 and Rules made thereunder for release of payments. The final payment will be made on completion of all works and on fulfillment by the contractor of all his liabilities under the contract.

34.2 CURRENCY OF PAYMENT

All payments under the contract shall be made in Indian Rupees only.

34.3 DUE DATES FOR PAYMENT

The advance amount shall be payable after fulfillment of all the conditions laid down in the Special conditions of contract, Clause 34.7.1 below and receipt of the Contractor’s invoice along with all necessary supporting documents for such advance payment. The price component of the advance amount will become due for payment within thirty (30) days of receipt of the contractor’s invoice. RSDCL will make progressive payment as and when the payment is due as per the terms of payment set forth in the accompanying special conditions of contract & clause 34.7 below. Progressive payments shall be payable by the RSDCL within a reasonable period from the date of receipt of contractor’s bill/invoice/debit. Note by the RSDCL, provided the documents submitted are complete in all respects and contractor have fulfilled all contractual formalities. The RSDCL will take all possible efforts to make payment to the contractor within thirty days. But in case of delay in payment, the RSDCL shall not be liable to pay any interest on the outstanding amount to the contractor.

34.4 PAYMENT SCHEDULE

The contractor shall prepare and submit to the Engineer for approval, a break-up of the Contract price. This contract price break-up shall be interlinked with the agreed detailed L-2 network of the contractor setting forth his starting and completion dates for the various key phases of Works prepared as per condition in Clause 12.0 of this section GCC of Volume-I. Any payment under the contract shall be made only after the contractor’s price break up is approved by the Engineer. The aggregate sum of the contractor’s price break-up shall be equal to the lump sum contract price. A price break up over valuing those items of supply which will be shipped first will not be accepted.

34.5 APPLICATION FOR PAYMENT

34.5.1 The contractor shall submit application for the payment in the prescribed proforma of RSDCL. Proforma for application for payment is enclosed as Annexure-IV of Volume-I.

34.5.2 Each such application shall state the amount claimed and shall set forth in detail, in the order of the payment schedule, particulars of the works including the works executed at site and of the equipment shipped/brought onto the site pursuant to the contract upto the date mentioned in the application and for the period covered since the last preceding certificate, if any.

34.5.3 Every interim payment certificate shall certify the Contract value of the works executed upto the date mentioned in the application for the payment certificate provided that no sum shall be included in any interim payment certificate in respect of the works that, according to the decision of the Engineer, does not comply with the contract, or has been performed, at the date of certificate prematurely.

34.6 MODE OF PAYMENT

Payment shall be made to supplier/contractor through RTGS/NEFT for quick and safe transfer of funds across the country (both local and outstation). The charges for transfer through RTGS/NEFT shall be on the part of supplier/contractor. The supplier/contractor shall furnish particulars to the payment making authorities of RSDCL in prescribed format to be provided by the RSDCL.
FOR SUPPLY OF MATERIAL:

34.6.1 Payment due on dispatch of equipment shall be made by the RSDCL through its bank or directly to the contractor as per the payment schedule.

34.6.2 The payment of the advance, any other supply payment, taxes and duties (whenever admissible), inland transportation (including port handling), insurance and the erection portion of the works shall be made directly to the contractor by RSDCL.

34.6.3 (a) The payment shall be made by Paying authority within a reasonable period from the date of receipt of the Contractor’s bills/Tax invoices from the consignee duly verified and submission of other documents by the contractor to him complete in all respect and supported by the requisite documents, if any duly verified and completion of all contractual formalities as per requirement of the purchase order. All the payment shall be released to the Contractor directly. The purchaser will take all possible efforts to make payment to the contractor within thirty days. But in case of delay in payment, the purchaser shall not be liable to pay any interest on the outstanding amount to the contractor.

(b) The Tax invoice for advance shall be submitted to the Director (Fin.) RSDCL, Jaipur.

(c) The contractor shall forward tax invoices as well as challans to the consignee in Four (4) copies (including original challan) mentioning copy No. on each invoice and challan.

(d) The consignee/site engineer will verify all the copies of challans in token of acceptance of the material in good condition and as per specification given in the purchase order in the prescribed format. The consignee/site engineer will retain one copy of receipted challan along with copy of Tax invoice for reference and further accounting at his end. One copy of receipted challans will be endorsed to the Director (Tech.) RSDCL, Jaipur. Remaining two (2) copies of receipted challans and Tax invoice (including original challans) will be forwarded to the Director (Fin.) RSDCL, Jaipur.

(e) No documents are to be routed through Bank. Documents other than invoices and challans will be sent by the contractor directly to the Paying authority, with a copy to the Director (Tech.) RSDCL, Jaipur.

(f) The GTR shall be drawn in favour of the consignee/site Engineer and shall be dispatched immediately.

FOR SURVEY & ERECTION PART:

34.6.4 (a) The payment shall be made by RSDCL within a reasonable period from the date of submission of the Contractor’s bills/Tax invoices complete in all respect and supported by the requisite documents, if any, duly verified and completion of all contractual formalities as per requirement. All the payment shall be released to the Contractor directly. The RSDCL will take all possible efforts to make payment to the contractor within thirty days. But, in case of delay in payment, the RSDCL shall not be liable to pay any interest on the outstanding amount to the contractor.

(b) All the Tax invoices shall be submitted to site as per the instruction of RSDCL’s site Engineer in-charge.

(c) The payment for works shall be made by the paying authority at monthly intervals on the certificate of the Engineer in accordance with the conditions set out herein. Item wise methods of measurements towards payments for different works are specified in Clause No. 55.0.

(d) The Contractor shall submit an application for interim payment to the nominated Engineer’s representative with a copy thereof to the Director (Tech.) RSDCL, Jaipur at the end of each month in a form approved by the Engineer. The application shall
include the following item, as applicable which shall be taken into account in the sequence listed below:

(i) The estimated value of the works executed up to the end of the month in question, obtained by applying the unit prices in the bill of quantities measured by the Engineer’s nominated representative.

(ii) The estimated value of the permanent works, obtained as in (i) above up to the end of the previous month.

(iii) 10% amount to be withheld, determined by applying the percentage to the difference of the amount under (i) & (ii) above.

(e) Within 30 days of receipt of the said application for interim payment, it shall be approved/amended such that in the opinion of the Engineer/Engineer’s representative the certificate reflects the amount due to the Contractor in accordance with the contract. In case(s) where there is a difference of opinion, as to the value of any item, the Engineer/Engineer’s representative has determined the amount due to the Contractor, a certificate called “Interim payment certificate” certifying the amount due to the Contractor shall be issued.

(f) CORRECTIONS:

The Engineer may by any Interim payment certificate make any corrections or modifications in any previous certificate (other than the one purporting to be a final payment certificate) which shall have been issued by him and shall have power to modify or withhold any interim payment certificate if the works or any part thereof are not being carried out to his satisfaction.

(g) FINAL ACCOUNT:

(i) Within 3 (three) months after the date of completion of works, the Contractor shall submit a draft statement of final account & supporting document to the Engineer/Engineer’s representative showing therein the details, the value of the works done in accordance with the contract, together with all further sums which the contract up to the date of the maintenance certificate (hereinafter called the “Contractor’s Draft Final Account”).

(ii) Within 3 (three) months after receipt of the Contractor’s Draft Final Account and of all information reasonably required for its verification, the Engineer/Engineer’s representative shall determine the value of all matters to which the Contractor is entitled under the contract. The Engineer/Engineer’s representative shall then issue to the Contractor a statement showing the final amount, to which the Contractor is entitled to, under the contract. The Contractor shall sign the Engineer’s statement of Final Account as an acknowledgement of the full and final value of the work performed under the contract and shall promptly submit a signed copy of the same to the Engineer/Engineer’s representative.

(h) FINAL CERTIFICATE:

(i) On receipt of the final Account, the Engineer/Engineer’s representative shall promptly prepare and issue to the Director (Fin.), RSDCL, Jaipur and the Contractor a Final payment certificate, certifying any further amount due to the Contractor in respect of the contract.

(ii) After issue of the certificate(s) by the engineer, the Contractor shall claim as per procedure given in Clause No. 34.6.

34.7 TERMS OF PAYMENT

34.7.1 The payments for the material/equipment/erection & Civil work shall be made as under
only after execution of the Contract Agreement and furnishing of Security Bank Guarantee of 2% of total contract value (valid upto 90 days from the date of handing over of all the Pooling Sub-stations after commissioning), Performance Bank guarantee of 10% of total contract value (valid upto one year from the date of handing over of all the Pooling Sub-stations after commissioning) and Project Implementation Schedule (L-2 Network) and its approval as per the following relevant clauses.

34.7.2 All the payments shall be made in accordance to Clause 34.3 above from the date of submission of duly verified bills and completion of all contractual formalities as per requirement of contract.

34.7.3 The payment terms for various components of Supply and Services shall be as under:

(A) Ex-Works Price Component for Main Equipment

(i) Interest Bearing Advance (Optional*): Ten percent (10%) of the Ex-works price of the main equipment/materials shall be paid as an advance on presentation of the following:

(a) Contractor’s unconditional acknowledgement of the Letter of Award and execution of Contract Agreement.

(b) Contractor’s invoice.

(c) An unconditional & irrevocable Bank Guarantee for the equivalent amount of advance as per proforma Annex-III attached to this Volume-I, which shall be initially valid upto the end of 90 days after the schedule date for successful completion of commissioning/taking over and shall be extended from time to time till 90 days after issuance of taking over certificate as may be required under the Contract.

(d) An unconditional & irrevocable Bank Guarantee for two percent (2%) of the total Contract price towards contract security guarantee as per proforma Annex-I attached to this Volume-I which shall be initially valid upto 90 days after the commissioning and issue of taking over certificate of the works on all respect in accordance with the clause No. 41.0 of Part ITB, Volume-I and shall be extended from time to time as may be required under the contract.

(e) An unconditional & irrevocable Bank Guarantee for Ten percent (10%) of the total Contract price towards contract Performance guarantee as per proforma Annex-II attached to this Volume-I which shall be initially valid upto 12 Calendar months after the commissioning and issue of taking over certificate of the works on all respect in accordance with the Clause No. 40.0 of Part ITB, Vol. I, and shall be extended from time to time as may be required under the contract.

(f) Submission of detailed L-2 network (Project Implementation schedule) based on the work schedule stipulated in the letter of award and its approval by the owner.

Note:* This payment is an optional payment. The Contractor has the option of taking the interest bearing advance or otherwise.

In case, the Contractor opts for this interest bearing advance, the same shall be paid to the Contractor on fulfillment of above conditions and an interest on monthly outstanding amount will be charged at the rate of 9.5 % per annum. The monthly outstanding amount for the purpose of calculating the interest shall be worked out at the end of each calendar month considering proportionate adjustment of advance against dispatch payment as per 34.7.3 (ii) below. The interest calculated shall be compounded monthly.

In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at Sl. No. (a), (d), (e) and (f) above within fifteen (15) days of issuance of contract.
(ii) Progressive Payment

(a) Payment equal to 60% # (Sixty percent) of ex-works value of the material/equipment shall be made to the contractor on receipt of material/ equipment at site on the basis of certificate issued by engineer in-charge that this much quantity as per the purchase/ work order has been brought by contractor at site. However, before dispatch of material/equipment at site, contractor shall be required to get it inspected and cleared from RSDCL. Material at site will remain in the custody of the contractor and he shall be liable for theft, damage or deterioration if any. It will be the responsibility of the contractor to get the material/equipment at site duly insured at his cost.

# In case, the Contractor opts not to take interest bearing advance then this payment shall be 70% instead of 60%.

(b) Further 20% (Twenty percent) payment of ex-works value will be paid after submission of verification/certification by engineer that equipment/ material has been erected.

(c) Final 10% (ten percent) payment of ex-works price of equipment/material shall be made after submission of taking over certificate after adjustment of due recoveries/ damages, if any and proof of submission of required number of reproducible, O&M manuals, approved drawings, data sheets, test reports, pamphlets and manuals of spares, maintenance and testing equipment of the Pooling Stations and soil resistance data at each Station.

(d) The payment of the bills, upto the order value will be released without limiting to the individual item quantity.

(B) Inland Transportation and Inland Insurance Charges

Inland transportation and insurance charges shall be paid to the Contractor on pro-rata basis, as per the unit rates indicated in the Notification of Award/ Letter of Award, after receipt of item at site and presentation of the invoices along with supporting documents by the Contractor. However, these charges will be subject to a limitation that the aggregate of all invoices does not exceed the total amount indicated in the Notification of Award/ Letter of Award.

34.7.4 TAXES AND DUTIES

Taxes and duties applicable as per Indian Tax laws, in respect of transaction between Company and the Contractor shall be paid by Company as per the Contract after each shipment against submission of Tax invoices and documentary evidence as applicable. Payment towards taxes & duties shall be released by Company directly to the Contractor.

34.7.5 HANDHOLDING CHARGES

100% payment of Handholding charges shall be released after the successful completion of 12 months period from the date of taking over certificate and issue of certificate by the in-charge of Pooling Sub-station(s) regarding satisfactory performance of handholding.

34.7.6 ERECTION AND CIVIL WORKS PRICE COMPONENT:

(i) Interest Bearing Advance (Optional**): Ten percent (10%) of the total contract price for service viz. ETC and its associated civil works component including supervision of erection charges shall be paid as initial advance on presentation of the following:

(a) Contractor's unconditional acknowledgement of the Letter of Award and execution of contract agreement.
(b) Contractor's invoice.

(c) An unconditional & irrevocable Bank Guarantee for the equivalent amount of advance as per proforma Annex-III attached to this Volume- I, which shall be initially valid upto the
end of 90 days after the schedule date for successful completion of commissioning/taking over and shall be extended from time to time till 90 days after issuance of taking over certificate as may be required under the Contract.

(d) An unconditional & irrevocable Bank Guarantee for two percent (2%) of the total Contract price towards contract security guarantee as per proforma Annex-I attached to this Volume-I which shall be initially valid upto 90 days after the commissioning and issue of taking over certificate of the works on all respect in accordance with the Clause No. 41.0 of Part ITB, Volume-I, and shall be extended from time to time as may be required under the contract.

(e) An unconditional & irrevocable Bank Guarantee for Ten percent (10%) of the total Contract price towards contract Performance Guarantee as per proforma Annexure-II attached to this Volume-I which shall be initially valid upto 12 Calendar months after the commissioning and issue of taking over certificate of the works on all respect in accordance with the clause No. 42.0 of Part ITB, Vol. I, and shall be extended from time to time as may be required under the contract.

(f) Submission of certificate of establishing of contractor’s site office(s) at respective site(s).

Note: **This payment is an optional payment. The Contractor has the option of taking the interest bearing advance or otherwise.

In case, the Contractor opts for this interest bearing advance, the same shall be paid to the Contractor on fulfillment of above conditions and an interest on monthly outstanding amount will be charged at the rate of 9.5% per annum. The monthly outstanding amount for the purpose of calculating the interest shall be worked out at the end of each calendar month against the progressive payment for the work done as per 34.7.6 (ii) below.

In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at Sl. No. (a), (d), (e) and (f) above within fifteen (15) days of issuance of contract.

(ii) **Progressive Payment:**

(a) Payment equal to Ninety percent (90%) (In case Contractor opts not to take interest bearing advance as above) or Eighty percent (80%) (in case Contractor opts to take the interest bearing advance) of the total Erection and Civil works price component shall be paid progressively pro-rata at unit rates on monthly basis upon certification by the engineer for the quantum of work completed and for the successful completion of quality check points involved in the erection.

(b) Further, Ten percent (10%) of the total erection, testing, commissioning and civil works price component shall be paid only after submission of taking over certificate issued by the engineer and after adjustment of due recoveries/damages, if any.

c) The payment of the bills, upto the order value will be released without limiting to the individual item quantity.

@ “Commissioning” for the purpose of payments shall mean satisfactory completion of all supplies, erection, inspection, commissioning checks and successful completion of all site tests and continuous energisation of the equipment/materials at rated voltage at site as per the Contract and to the satisfaction/approval of RSDCL.

34.7.7 **TAXES AND DUTIES:**

In case of direct transactions between the RSDCL and the Contractor, taxes and duties, shall be paid at actuals as applicable during contractual delivery period or actual delivery period, which will be lower, against submission of Tax invoices and documentary evidence.
34.7.8 **TYPE TEST CHARGES:**

The typetests shall be conducted as per requirement of specification Volume–II by the bidder in a Govt./Govt. approved/Govt. recognized/NABL accredited test laboratory/ILAC i.e. International Laboratory Accreditation Co-operation (in case of foreign laboratories) or the certificate of type test conducted at manufacturer's works duly witnessed by representative of any Electricity Board or Company/Govt. agency/PGCIL/NTPC (wherever specified in technical specification for particular item) or the certificate of type test conducted in the manufacturer's own lab located in the foreign country duly witnessed by independent agencies per relevant standards. The type test certificates should not be older than 7 years as on the date of Technical bid opening for which the date of conducting of test shall be considered. However, no separate type test charges shall be paid to the bidders.

35.0 **DEDUCTIONS FROM CONTRACT PRICE**

All cost, damages or expenses which the RSDCL may have paid for which under the contract, the Contractor is liable, may be deducted by the RSDCL from any money due or become due by him to the Contractor under this or any other contract or may be recouped by suit or otherwise from the Contractor. Any sum of money due and payable to the Contractor (including Security Deposit returnable to him) under this contract may be appropriated by the RSDCL and set off against any claim of the RSDCL for the payment of a sum of money arising out of or under any contract made by the Contractor with the RSDCL or may be recovered by action of LAW or otherwise.

**D- SPARES, IF APPLICABLE**

36.0 **SPARES (IF APPLICABLE)**

36.1 All the spares for the equipment under the contract will strictly, conform to the specification and documents and will be identical to the corresponding main equipment/ components supplied under the contract and shall be fully interchangeable.

36.2 All the mandatory spares covered under the contract shall be produced along with the main equipment as a continuous operation and the delivery of the spares will be affected along with the main equipment in a phased manner and the delivery would be completed by the respective dates for the various categories of equipment as per the agreed network. In case of recommended spares, the above will be applicable provided the order for the recommended spares has been placed with the contractor prior to commencement of manufacture of the main equipment.

36.3 The quality plan and the inspection requirement finalized for the main equipment will also be applicable for the corresponding spares.

36.4 The contractor will provide the owner with the manufacturing drawings, catalogues, assembly drawings and any other document required by the owner so as to enable the owner to identify the recommended spares. Such details will be furnished to the owner as soonas they are prepared but in any case not later than six months prior to commencement of manufacture of the corresponding main equipment.

36.5 The contractor will provide the RSDCL with all the addresses and particulars of his sub-suppliers while-placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the RSDCL, if so desires, will have the right to place order(s) for spares directly on them on mutually agreed terms based on offers of such vendors.

36.6 **WARRANTY FOR SPARES (IF APPLICABLE)**

The contractor shall warrant that all spares supplied will be new and in accordance with contract documents and will be free from defects in design, materials and workmanship and shall further guarantee as under:
36.6.1 FOR 3 YEARS OPERATIONAL SPARES (IF APPLICABLE):

(a) The spares of both categories (i.e. Mandatory & others) as recommended by the contractor for three (3) years successful operation will be manufactured with main equipment & the warrantee of such equipments will be 12 months from the scheduled date of commercial operation of the last unit of main equipment under the contract. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to the owner unless a joint examination and analysis by the owner and the contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same warranty as applicable to the replacement made for the defective original part/component provided that such replacement for the original equipment and the spare replaced are again manufactured together. The discarded spare parts will become the property of the contractor as soon as they have been replaced by the contractor.

(b) For the item of spares ordered/to be ordered by the RSDCL for 3 years operational requirement of the equipment, which are not manufactured as a continuous operation together with the manufacture of the corresponding main equipment/component, will be warranted for 6000 hrs. of trouble free operation, if used within a period of 18 months (reckoned from the date of delivery at site). However, if such spare parts are put to use after 18 months of the delivery at site then the guarantee of such spares will stand valid till the expiry of 36 months from the scheduled date of the completion of commissioning of the last unit of equipment or 6000 hrs. of trouble free operation after such spares are put in service, whichever is earlier.

36.6.2 The warranty of spares that are not used within 18 months from the respective dates of the delivery at site covered in para (b) above will, however, be subject to the condition that all such spares have been stored/maintained/preserved in accordance with contractor’s standard recommended practice, if any, and the same have been furnished to the owner.

36.7 To enable the owner to finalize the requirement of recommended spares which are ordered subsequent to placement of order for main equipment in addition to necessary technical details catalogue and such other information brought out here-in-above, the Contractor will also provide a justification in support of reasonableness of the quoted prices of spares which will, inter-alia, include documentary evidence that the prices quoted by the contractor to the owner are not higher than those charged by them from other customers in the same period.

36.8 In addition to the spares recommended by the Contractor, if the owner further identifies certain particular items of spares, the contractor will submit the prices and delivery quotations for such spares within 30 days of receipt of such request with validity period for 6 months for consideration by the owner and placement of order for additional spares if owner so desires.

36.9 The contractor/supplier shall guarantee the long term availability of spares to the owner for the full life of the equipment covered under the contract. The contractor shall guarantee that before going out of production of spare parts of the equipment, he shall give the RSDCL at least twelve (12) months advance notice so that the later may order his bulk requirement of spares if he so desires. The same provision will also be applicable to Sub-contractor of any spares by the contractor or his sub-contractors. Further, in case of discontinuance of manufacture of any spares by the contractor or his sub-contractors, the contractor will provide the RSDCL, two years in advance, full manufacturing drawings, material specifications and technical information required by the RSDCL for the purpose of manufacture of such items.

36.10 Further, in case of discontinuance of supply of spares by the contractor or his sub-contractors, the contractor will provide the RSDCL with full information for replacement of such spares with other equivalent makes, if so required by the RSDCL.

36.11 The prices of all future requirements of items of spares beyond 3 years operational requirement will be derived from the corresponding ex-works price at which the order
for such spares have been placed by the owner as part of mandatory spares or recommended spares. Ex-works order price of future spares shall be computed in accordance with the price of spares indicated in the contract. The above option for procuring future long term requirement of spares by the owners shall remain valid for a period of 5 years from successful completion of commissioning last unit of equipment.

36.12 The contractor will indicate in advance the delivery period of the items of spares, which the owner may procure in accordance with above sub-clause. In case of emergency requirements of spares, the contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

36.13 In case the contractor fails to supply the mandatory, recommended or long term spares in accordance with the terms stipulated above, the owner shall be entitled to purchase the same from alternate sources at the risk and the cost of the contractor and recover from the contractor, the excess amount paid by the RSDCL over the rates worked on the above basis. In the event of such risk purchase by the RSDCL, the purchases will be as per the works and procurement policy of the RSDCL prevalent at the time of such purchases and the RSDCL at his option may include a representative of the contractor in finalizing the purchases.

36.14 It is expressly understood that the final settlement between the parties in terms of relevant clauses of the bidding documents shall not relieve the contractor of any of his obligations under the provision of long term availability of spares unless otherwise discharged in writing by the owner.

E. RISK DISTRIBUTION

37.0 TRANSFER OF THE TITLE

37.1 Transfer of the title in respect of equipment and materials supplied by the contractor to RSDCL in pursuant to the terms of the contract shall pass on to RSDCL with negotiation of dispatch documents.

37.2 This transfer of title shall not be constructed to mean the acceptance and the consequent 'Taking over' of equipment and materials. The contractor shall continue to be responsible for the quality and performance of such equipment and materials and for their compliance with the specifications until 'Taking over' and the fulfillment of guarantee provisions of this contract.

37.3 This transfer of title shall not relieve the contractor from the responsibility for all risks of loss or damage to the equipment and materials as specified under the clause entitled 'Insurance' of this section.

38.0 INSURANCE

38.1 The contractor at his cost shall arranged, secure and maintain all insurance as may be pertinent to the works and obligatory in terms of law to protect his interest and interests of the owner against all perils detailed herein. The form and the limit of such insurance as defined herein together with the under-writer in each case shall be acceptable to the owner. However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage at all time during the period of contract shall be of contractor alone. The contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance covers to be taken by the contractor shall be in a joint name of the owner and the contractor. The contractor shall, however, be authorized to deal directly with insurance company or companies and shall be responsible in regard to maintenance of all insurance covers. Further, the insurance should be in freely convertible currency.

38.2 Any loss or damage to the equipment during handling, transportation, storage, erection, putting into satisfactory operation and all activities to be performed till the successful completion of commissioning of the equipment shall be to the account of the contractor. The
contractor shall be responsible for preference of all claims and make good the damages or loss by way of repairs and/or replacement of the equipment, damages or lost. The transfer to title shall not in any way relieve the contractor of the above responsibilities during the period of contract. The contractor shall provide the owner with copy of all insurance policies and documents taken out by him in pursuance of the contract. Such copies of documents shall be submitted to the owner immediately after such insurance coverage. The contractor shall also inform the owner in writing at least sixty (60) days in advance regarding the expiry/cancellation and/or change in any of such documents and ensure revalidation, renewal etc. as may be necessary well in time.

38.3 The perils required to be covered under the insurance shall include, but not be limited to fire, earth quake and allied risks, miscellaneous accidents(erection risks), workman compensation risks, loss or damage in transit, theft, pilferage, riot and strikes and malicious damages, civil commotion, weather conditions, accidents of all-kinds, etc. The scope of such insurance shall be adequate to cover the replacement/ reinstatement cost of the equipment for all risks uptill including delivery of goods and other costs till the equipment is delivered at site. The insurance policies to be taken should be on replacement value basis and/or incorporating escalation clause. Notwithstanding the extent of insurance cover and the amount of claim available from the underwriters, the contractor shall be liable to make good the full replacements/ rectification value of all equipment/materials and to ensure their availability as per project requirements.

38.4 All costs on account of insurance liabilities covered under the contract will be on contractor's account and will be included in contractor price. However, the owner may from time to time, during the pendency of the contract, ask the contractor in writing to limit the insurance coverage, risks and in such a case, the parties to the contract will agree for a mutual settlement, for reduction in contract price to the extent of reduced premia amount. The contractor, while arranging the insurance shall ensure to obtain all discounts on premia which may be available for higher volume or for reason of financing arrangement of the project.

38.5 The clause entitled ‘insurance’ under this section, covers the additional insurance requirements for the portion of the works to be performed at the site.

(a) On receipt of an order, the supplier shall be required to get the material/equipment on order fully insured from the General Insurance Corporation of India or any other Nationalized Insurance Company against any loss, damage, and/or pilferage in transit from the place of despatch to the destination station(s) and for further period of 60 days after receipt of material/equipment at destination.

(b) The supplier shall be responsible for safe arrival at destination and receipt of material/equipment by the consignee(s).

(c) In case of any loss/damage/pilferage etc, the supplier shall replace free of cost such missing/damaged or lost material on receipt of the report thereof from the consignee(s). Such reports shall be made to the supplier by the consignee(s) within a period of 30 days from the date of receipt of each consignment by him/them.

(d) The replacement of shortages/damages/losses shall be made or defects rectified at the consignees store(s) within a period of 60 days from the date of such reports, failing which the purchaser reserves the right to forfeit the security deposit and/or operate the performance bank guarantee, if any and/or take any other appropriate action as may be expedient.

(e) The defective damaged material/equipment shall be returned to the supplier at his cost only after replacement thereof has been made to the satisfaction of the consignee(s)/purchaser.

(f) In case the damaged/defective material/equipment or a part thereof warrants return at the supplier's work for necessary rectification, the Contractor shall be required to furnish a Bank guarantee from any Scheduled/ Nationalized bank equivalent to the value of such
materials plus taxes as claimed by the supplier. The period for return of rectified material/equipment as well as validity of the Bank guarantee shall be as mutually agreed upon, without affecting the date of contractual completion period (including approved extension thereof, if any).

39.0 **LIABILITY FOR ACCIDENTS AND DAMAGES**

Under the contract, the contractor shall be responsible for loss or damage to the plant until the successful completion of commissioning as defined elsewhere in the bid document.

(a) The Contractor shall be responsible for loss, damage or depreciation of the substation and line until the same is taken over under clause No.31 above or is deemed under that clause to have been taken over, provided always that the Contractor shall not be responsible for any such loss, damage and depreciation occurring during such period that the plant is operated by the purchaser's staff prior to being taken over in accordance with clause No.31 above.

(b) Until the plant is taken over or is deemed to have been taken over as aforesaid, the Contractor shall also be liable for and shall indemnify the purchaser in respect of all injury to person or damage to property resulting from the negligence of the Contractor or his workman or sub Contractors or from defective design or work but not from any other cause.

(c) Provided that the Contractor shall not be liable for any loss or profit or loss of Contract or any other claim made against the purchaser not already provided for in the contract, not for any injury or damage caused by or arising from the acts of the purchaser or of any other person or due to circumstances over which the Contractor has no control, not shall his total liability for loss, damage or injury under this clause exceed the total value of the Contract.

(d) The Contractor will indemnify and save harmless the purchaser against all actions, suits, claims, demands, costs, or expenses arising in connection with injuries (other than such as may be attributable to the purchaser or his employees) suffered prior to the date when the plant shall have been taken over under clause No.31 hereof by persons employed by the Contractor or his sub-Contractor on the work, whether at common law or under the workman’s compensation Act 1923 or any other statute in force at the date of contract relating to the question of the liability of employees for injuries suffered by employees and will if called upon to do so take out the necessary policy or policies of insurances to cover such indemnity.

(e) The Contractor shall insure against such liabilities with an insurer approved by the Engineer and shall continue such insurance, during the whole of the time that any person(s) are employed by him on the works and shall, when required, produce to the engineer or the Engineer’s representative such policy of insurance and the receipt for payment of the current premium. Provided always that, in respect of any persons employed by any sub-Contractor, the Contractor's obligation to insure as aforesaid under this sub-clause shall be satisfied if the sub-Contractor shall have insured against the liability in respect of such persons in such manner that the Engineer is indemnified under the policy, but the Contractor shall require such sub-Contractor to produce to the Engineer or the Engineer’s representative, when required, such policy of insurance and the receipt for the payment of the current premium.

40.0 **DELAYS BY OWNER OR HIS AUTHORISED AGENTS**

40.1 In case the contractor’s performance is delayed due to any act of omission on the part of the owner or his authorized agents, then the contractor shall be given due extension of time for the completion of the works, to the extent such omission on the part of the owner or his authorized agents, has caused delay in the contractor’s performance of the contract. Regarding reasonablenessor otherwise of the extension of time, the decision of the RSDCL shall be final.
40.2 The contractor shall not be entitled to claim any compensation for such delays.

41.0 **DEMURRAGE, WHARFAGE, ETC.**

All demurrage, wharfage and other expenses, if incurred due to delayed clearance of the material or any other reason shall be to the account of the contractor.

42.0 **FORCE MAJEURE**

42.1 Force majeure is herein defined as any cause which is beyond the control of the contractor or the RSDCL as the case may be, which they could not foreseen and which substantially affects the performance of the contract, such as:

(a) Natural phenomena, including but not limited to floods, droughts, earthquakes and epidemics.

(b) Acts of any Government, domestic or foreign, including but not limited to war, declared or undeclared, priorities, guaranties, embargoes.

(c) If at any time during the continuance of the contract, the progress in whole or in part is prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, fire, floods, explosion, epidemics, quarantine restrictions, strikes, lockouts or any acts of Gods (herein after referred to as events), then provided, a notice and adequate proof of production/ dispatch/ execution having suffered on account of these events, is given within 21 days from the day of occurrence thereof, the provisions of sub-para of this clause shall not be invoked by the purchaser, provided further that the execution under the contract shall be resumed, as soon as practicable after such event(s) has/ have ceased to exist and the decision of the purchaser as to whether execution so resumed or not, shall be final and conclusive. Provided further that in case the strike/lockout prolongs beyond a period of 30 days, the Contractor shall immediately inform about it to the purchaser, in which case the purchaser reserves the right to procure the material /equipment/ get the work on order or part thereof executed from any other source at the risk and cost of the Contractor.

42.2 The contractor or the owner shall not be liable for delays in performing his obligations resulting from any force majeure cause as referred to and/or defined above.

The date of completion will, subject to hereinafter provided, be extended by a reasonable time even though such cause may occur after contractor’s performance of obligation has been delayed due to other causes.

42.3 Non availability/scarcity/non-allocation of raw material shall not constitute as a ‘force majeure condition’ in any case and it will be sole responsibility of the Contractor to arrange the raw material for timely execution of the order.

43.0 **SUSPENSION OF WORK**

(a) The Contractor shall on the written order of the Engineer, suspend the progress of the works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall during such suspension properly protect and secure the work, so far it is necessary in the opinion of the Engineer. The extra cost incurred by the Contractor in giving effect to the Engineer’s instructions under this clause shall be borne and paid by the owner, unless such suspension is:

(i) Otherwise not provided for in the contract.
(ii) Necessary by reason of some default on the part of the Contractor or.
(iii) Necessary by reason of climatic conditions on the site or.
(iv) Necessary for the proper execution of the works or for the safety of works or any part thereof in so far as such necessity does not arise from any act or default by the Engineer/Engineer’s representative or from any of the expected risks defined in clause No.38 of GCC and 28 of ECC thereof.
(b) Provided that the Contractor shall not be entitled to recover any such extra cost unless he gives written notice of his intention to claim to the Engineer within thirty days of the Engineer’s order. The Engineer shall settle and determine such extra payment and/or extension of time under clause No. 59.4 below to be made to the Contractor in respect of such claim as shall in the opinion of the Engineer be fair and reasonable.

44.0 CONTRACTOR’S DEFAULT

44.1 (a) If the Contractor shall neglect to execute the work with due diligence and expedition or shall refuse or neglect to comply with any reasonable orders given to him in writing by the engineer in connection with the work or shall contravene the provisions of contract, the purchaser may give notice in writing to the Contractor calling upon him to make good the failure, or neglect contravention complained of.

(b) Should the Contractor fail to comply with such notice within a period considered reasonable by the purchaser from the time of service thereof, in the case of being made good within the time, or otherwise within such time as may in the opinion of the purchaser be reasonably necessary for making it good, then and in such case the purchaser shall have the option and be at liberty to take the work wholly or in part out of Contractor’s hands and may carry on the work necessary to complete the work envisaged in the contract, either by himself or through his agents or may re-contract at reasonable price with any other person or persons to execute the same or any part thereof and provide any other materials, tools, tackles or labour for the purpose of completing the works or any part thereof. In such event the purchaser shall have free use of all Contractor’s materials, tackles or other things that may have been at the time on the site in connection with the work without being responsible to the Contractor, for fair wear and tear of the same be entitled to seize and take precession and to the exclusion of any right of the Contractor over the same and the purchaser shall be entitled to retain and apply balance sum which may otherwise be then due on the contract by him to the Contractor or such part thereof as may be necessary, to the payment of the cost of execution of such work aforesaid or of completing of works as the case may be.

(c) If the cost of executing the work as aforesaid shall exceed the balance due to the Contractor and Contractor fails to make good the defects the said materials tools, tackles, construction plant or other things, the property of the Contractor as may not have been used up in the completion of works, may be sold by the purchaser and proceeds applied towards the payment of such difference and the cost of the incidental to such sale. Any outstanding balance existing after crediting the proceeds of such sale be paid by the Contractor on the certificate of the engineer but when all expenses costs and charges incurred by the purchaser in the completion of the work are paid by the Contractor, all such materials, tools, tackles, construction plant or other things not used up in the completion of the works and remaining unsold shall be removed by the Contractor. If the proceeds of the above sale of the Contractor’s materials, tools, tackles, construction plant etc. are insufficient to cover the cost of executing the aforesaid work, the balance remaining, after crediting the proceeds of such sale shall be recoverable from the Contractor by the action of law, or operating bank guarantees furnished or security deposits available with the purchaser. Such payment of excess amount shall be independent of the recovery for which the Contractor shall have to pay on account of the completion of works is delayed.

44.2 In addition, such action by the owner as aforesaid shall not relieve the contractor of his liability to pay against recovery clause for delay in completion of works as defined in clause 14.0 of this section.

44.3 Such action by the owner as aforesaid the termination of the contract under this clause shall not entitle the contractor to reduce the value of the contract performance guarantee nor the time thereof. The contract performance guarantee shall be valid for the full value and for the full period of the contract including guarantee period.
45.0 **TERMINATION OF CONTRACT ON OWNER'S INITIATIVE**

45.1 The RSDCL reserves the right to terminate the contract either in part or in full due to reasons other than those mentioned under clause entitled contractor's default. The RSDCL shall in such an event give fifteen (15) days notice in writing to the contractor of his decision to do so.

45.2 The contractor upon receipt of such notice shall discontinue the work on the date and to the extent specified in the notice, make all reasonable efforts to obtain cancellation of all orders and contracts to the extent they are related to the work terminated and terms satisfactory to the owner, stop all further sub-contracting or purchasing activity related to the work terminated, and assist the owner in maintenance, protection and disposition of the works acquired under the contract by the owner.

45.3 In the event of such a termination, the contractor shall be paid compensation, equitable and reasonable, dictated by the circumstances prevalent at the time of termination.

45.4 If the contractor is an individual or a proprietary concern and the individual or the proprietor dies and if the contractor is a partnership concern and one of the partners dies then unless the owner is satisfied that the legal representatives of the individual contractor or of the proprietor of the propriety concern and in the case of partnership, the surviving partners, are capable of carrying out and completing the contract the owner shall be entitled to cancel the contract as to its uncompleted part without being in any way liable to payment of any compensation to the estate of deceased contractor and/or to the surviving partners of the contractor's firm on account of the cancellation of the contract. The decision of the owner that the legal representatives of the deceased contractor or surviving partners of the contractor’s firm cannot carry out and complete the contract shall be final and binding on the parties. In the event of such cancellation the owner shall not hold the estate of the deceased contractor and/or the surviving partners of the contractor's firm liable to damages for not completing the contract.

46.0 **FRUSTRATION OF CONTRACT**

46.1 In the event of frustration of the contract because of supervening impossibility in items of section 56 of the Indian Contract ACT, the parties shall be absolved of their responsibility to perform the balance portion of the contract, subject to provisions contained in sub-clause 46.3 below.

46.2 In the event of non-availability or suspension of funds for any reasons whatsoever (except for reason of willful or flagrant breach by the owner) and/or contractor then the works under the contract shall be suspended.

46.3 Furthermore, if the owner is unable to make satisfactory alternative arrangements for financing to the contractor in accordance with the terms of the contract within three months of the event, the parties hereto shall be relieved from carrying out further obligations under the contract treating it as frustration of the contract.

46.4 In the event referred to in sub-clauses 46.1 and 46.2 above, the parties shall mutually discuss to arrive at reasonable settlement on all issues including amounts due to either party for the work already done on "quantum merit" basis which shall be determined by mutual agreement between the parties.

47.0 **GRAFTS AND COMMISSIONS ETC**

Any graft, commission, gift or advantage given promised or offered by or on behalf of the contractor or his partner, agent, officers, director, employee or servant or any one on his or their behalf in relation to the obtaining or to the execution of this or any other contract with the owner, shall in addition to any criminal liability which it may incur, subject the contractor to the cancellation of this and all other contracts and also to payment of any loss or damage to the owner resulting from any cancellation. The owner shall then be entitled to deduct the amount so payable from any monies otherwise due to contractor under the contract.
G. RESOLUTION OF DISPUTES

48.0 SETTLEMENT OF DISPUTES

(a) All disputes, differences, questions whatsoever so arising between RSDCL& the contractor upon or in relation to or in connection with contract shall be deemed to have arisen at Jaipur (Rajasthan) only and no Court, other than courts in Jaipur shall have jurisdiction to entertain the same.

The RSDCL will constitute the centralized standing Committee for settlement of disputed claims under condition of contract relating to RSDCL. The committee shall consider all cases for settlement of disputed claims relating to purchases, works, turnkey contracts and labour contracts, civil works etc. The committee shall also take decision whether a particular matter is required to be referred to the Board for approval before settlement. The matter for settlement shall only be referred to the centralized standing committee of RSDCL by following the guide lines detailed below:-

1) Disputes will be referred contract wise.
2) Disputes involving amount above Rs.1.00 lacs only will be referred/ entertained.
3) Non-refundable fee shall be deposited by the contractor/ firm @ 2% of disputed amount as claimed by the contractor/firm subject to maximum fee of Rs.1.00 lac.
4) In case of disputes, application for settlement may be submitted incorporating all detail to the Director (Tech.) RSDCL, Jaipur.

The centralized standing committee fees shall be deposited in cash/demand draft with the Director (Fin.), RSDCL, Jaipur and shall furnish receipt thereof with a request for referring their disputes to the centralized standing committee for decision.

For settlement, the firm shall furnish their application indicating the details of disputes/grievances alongwith requisite settlement fee within a period of six months after receiving communication from Director (Tech.) RSDCL, Jaipur giving rise to cause of disputes/grievances.

49.0 RECONCILIATION OF ACCOUNTS

The contractor shall prepare and submit every two months, a statement covering payments claim and the payment received vis-à-vis the works executed, for reconciliation of accounts with the RSDCL. The contractor shall also prepare and submit a detailed account of RSDCL issue material received and utilized by him for reconciliation purpose in a format to be discussed and finalized with the owner before the award of the contract.

50.0 INSPECTION AND TESTING

50.1 The engineer and his duly authorized representative shall have at all reasonable times access to the contractors premises of works and shall have the power at all reasonable time to inspect drawing of any portion of the work or examine the materials and workmanship of the plant is being manufactured on other premises, the contractor shall obtain for the engineer and for his duly authorized representative permission to inspect it as if the plant was manufactured on the contractor’s own premises.

50.2 The engineer shall on giving seven days, notice in writing to the contractor setting out any grounds of objections which he may have in respect of the work, be at liberty to reject any drawing and all or any plant, or workmanship connected with such work which in his opinion are not in accordance with the contract or are in his opinion, defective for any reason whatsoever.

50.3 The contractor shall state the places of manufacture, testing and inspection of various equipments offered by him. Unless specifically provided otherwise all tests shall be made at the contractor’s/manufacturer’s works before shipment.
50.4 The contractor shall intimate atleast 15 days in advance through notice(s) about the readiness of material for dispatch commensurate with specific delivery schedule so as to enable the purchaser to depute his representative for inspection testing and checking of the material/equipment. For this purpose the date of receipt of the letter in the office of the purchasing authority shall be deemed as the date of call for inspection and not the date mentioned in the letter and the date of despatch. In case, material/equipment is not found ready by the representative of the purchaser deputed for inspection to with tolerance of (-) 10% or if the inspection is not got carried out to the extent of the quantity indicated in the inspection call by any reason(s) on account of the supplier, an amount of Rs. 1500.00 only for the supplier's works located in Rajasthan and an amount of Rs. 5000.00 only for the supplier's works located outside Rajasthan, will become payable by the supplier/contractor on this account to the Director (Fin.), RSDCL, Jaipur. The supplier/contractor will deposit the amount with the Director (Fin.), RSDCL, Jaipur, immediately under intimation to this purchasing authority, failing which the subsequent call for inspection shall not be entertained.

50.5 The material/equipment shall be offered duly packed so as to enable the inspecting officer to seal. The supplier/ Contractor shall provide such packing of the goods as is required to prevent their damages or deterioration during transit to their final destination was indicated in the contract. The packing shall be sufficient to withstand without limitation rough handling during transit to their final destination as indicated in the contract. The packing shall be sufficient to withstand without limitation Rough handling during transit and exposure to extreme temperature salt and precipitation during transport and open storage. Packing case size and weights shall be taken into consideration where appropriate, remoteness of the goods final destination and absence of heavy mechanized handling facilities at all points in transit. The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the contract or in any subsequent instruction ordered by the purchaser.

50.6 In all cases where the contract provides for tests, whether at the premises of works of the contractor or any sub-contractor, test at site the contractor except where otherwise specified shall provide free of charge to the RSDCL such labour, materials electricity fuel water, stores apparatus and instruments as may reasonably be demanded to carry out efficiently such tests of the plant, in accordance with the contract and shall give facilities to the engineer or his authorized representative to accompany such testing.

50.7 RSDCL reserve to himself the right of having any inspection or special test of a reasonable nature at contracts premises or at sites in addition to those prescribed in applicable standards and the enclosed technical specification.

50.8 When the tests have been satisfactorily completed at the contractor's or sub-contractor's works, the engineer shall issue a certificate to that effect but if the tests were not witnessed by the engineer or his representative, the certificate would be issued after the receipt of test certificate by the engineer. No plant shall be shipped before such a certificate has been issued. The satisfactory completion of these tests or the issue of this certificate shall not bind the purchaser to accept the plant, should it on further tests after erection, be found not to be comply with the contract.

50.9 The authorized representative of the purchaser shall have at all reasonable times access to the works and premises of the supplier and/ or his associates if any, and shall be free to inspect the works, examine and test the product(s) including raw material used and the workmanship employed during/ after manufacture.

50.10 The supplier shall also furnish the latest calibration certificates of the testing instruments/equipment used for the testing of the material/ equipments as covered in the purchase order, to the inspecting officer. The testing instruments/machines should be got calibrated by the supplier from time to time from the manufacturer of the testing instruments or any Govt. recognized/approved testing laboratory. The calibration certificate should not in any case, be older than one year at the time of presenting the same to the Inspection Officer. In case however, the supplier fails to comply with the
conditions as aforesaid a certificate in writing of the inspector/representative of the RSDCL that the supplier has failed to provide the facilities shall be conclusive.

50.11 Unless the inspection is specifically waived, no material shall be dispatched without inspection and clearance for dispatch by the purchaser’s representative.

50.12 RSDCL reserve the right to reject all or any part of the material being manufactured or awaiting dispatch, due to any defect or deviations from the standard specification prescribed as observed during the inspection. In case of any dispute/difference in this regard the decision of the Director (Tech), RSDCL, Jaipur shall be final and binding.

50.13 RSDCL also reserves the right to get the material/ equipment tested in any recognised Govt. Laboratory & claiming any compensation or rejecting the material/equipment, if not found in accordance with the specification. All charges consequent to such rejection and replacement/ rectification shall be borne by the contractor.

50.14 The contractor shall arrange free of charges, the suitable accommodation and transport facility for local journey to the RSDCL’s representative(s) nominated for inspection.

Supplier shall arrange “To and Fro” Air tickets of economy class for journey of inspecting officer(s) from nearest airport of the work place of inspecting officer to their works or the place where inspection is to be carried out and back at suppliers cost after coordinating with the inspecting officer(s). Suitable transport facility for the inspecting officer(s) from his work place to the nearest airport for “to and fro” journey will also be arranged by the supplier/contractor.

In case, if place of inspection is not connected through Air, the supplier will arrange “To and Fro” Air tickets of economy class at their cost up to the nearest Airport of the place of inspection and onward journey from nearest airport to place of inspection and back by suitable means i.e. Taxi/Train (2nd A.C. class) at the cost of supplier/contractor.

In case, the place of inspection is within 500 Kms. distance from the headquarter of the inspecting officer, the supplier will make suitable traveling arrangement up to the destination of inspection and back by Taxi/Train (2nd A.C. class) at supplier’s/contractor’s cost.

No deduction towards air fare/traveling expenses will be made by the payment making authority, if the inspection is waived by the competent authority.

51.0 FURTHER CORRESPONDENCE:

All correspondence pertaining to the bidding documents in respect of any clarification required should be addressed to the Director (Tech), Rajasthan Solarpark Development Company Ltd. E-166, Yudhishthir Marg, C-Scheme, Jaipur.

52.0 ACCEPTANCE OF THE ORDER:

The order shall be placed in favour of the successful bidder. The successful bidder, on receipt of the order, shall convey the acceptance of order to the Director (Tech), Rajasthan Solarpark Development Company Ltd. E-166, Yudhishthir Marg, C-Scheme, Jaipur, within seven days of thereceipt of order, failing which, it will be presumed that the terms and conditions incorporated in the order are acceptable to the successful bidder.

53.0 NODAL OFFICER& GENERAL APPROVALS

53.1 The Director (Tech) shall appoint a nodal officer for site monitoring of electrical and civil works and de-bottlenecking for timely completion of milestones on RSDCL part.

53.2 Fortaking decisions regarding works beyond scope of contract, prior approval before taking up works from followings officers/Engineers shall be required as under:
**Civil works**: GM (Solar Park) in concurrence with the Director (Tech) & Director (Fin).

**Electrical/Switch yard works**: GM (Solar Park) in concurrence with the Director (Tech) & the Director (Fin.).

53.3 The Civil drawings/design and drawings of equipments/items of Pooling Sub-stations furnished by the firm shall be checked/approved by the Director(Tech.) RSDCL, Jaipur.

54.0 **TEST CERTIFICATES:**

(a) In the event of order, the contractor shall furnish the original/attested photocopies of the latest type test certificates of all the items under supply as per specification.

(b) In case of any specific alternative requirement of type tests, the same shall be furnished as per Volume-II.

(c) The supplier shall be required to furnish the routine/manufacturer’s factory test certificate(s) for the tests carried out during manufacturing in accordance with the relevant standard specifications.

55.0 **DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:**

55.1 Delivery of goods shall be made by the supplier/contractor in accordance with the terms specified by the purchaser in its schedule of requirements and purchase order.

55.2 The Contractor shall open stores at the sites and all the material required for the works shall be consigned in the name of officer designated by RSDCL and the despatched documents sent to him. The despatched documents received by the RSDCL shall be endorsed to the designated representative of the Contractor at the site and handed over to him so that the Contractor’s representative can arrange to collect these materials from the transport company and transport the same to the site/stores of the Contractor. All incidental liabilities like wharfage/demurrage/damage, loss etc. shall be sole responsibility of the Contractor.

55.3 The Engineer (Consignee) will issue receipt of material on Contractor’s challans and also issue a certificate thereon that these materials have been issued to the Contractor for execution of the Erection work against the Order No.............dated.............and the same shall be furnished alongwith the following documents to the Director (Fin.), RSDCL, Jaipur for release of payment.

(i) Copies of the supplier’s/Contractor’s invoice showing the goods description, quantity, unit price and the total amount.

(ii) Inspection certificate issued by the nominated inspector of the owner & the supplier’s factory inspection certificate/report.

The Contractor shall also furnish an irrevocable INDEMNITY bond for the total value of the material required for the works. This shall be valid until handing over of the completed project and reconciliation of the materials paid for, used for the works and returned to RSDCL.

55.4 **INCIDENTAL SERVICES:**

Prices charged by the supplier for incidental services not included in the contract shall be agreed upon in advance by parties and shall not exceed the prevailing rates charged to the other parties by the supplier/contractor for similar services.

55.5 **CHANGE ORDER:**

The RSDCL, may at any time, by a written order given to the Contractor, may make changes within the general scope of the contract in any one or more of the following:

(a) Drawings, designs or specifications for the goods to be supplied under the contract are to be specifically manufactured for the purchaser.

(b) The method of packing.
(c) The services to be provided by the supplier.

If any such change causes an increase or decrease in the cost of, or the time required for the supplier's performance of any part of the work under the contract whether changed or not changed by the order, an equitable adjustment shall be made in the contract prices and contract shall accordingly be amended. Any claims by the supplier for adjustment under this clause must be asserted within Thirty (30) days from the date of the supplier's receipt of the purchaser's changed order.

56.0 ENGINEER'S SUPERVISION:

All the work shall be carried out under the direction and to the reasonable satisfaction of the Engineer. The Contractor shall be responsible for the correctness of the positions, levels and dimensions of the works according to the Drawings not-withstanding that he may have assisted by the Engineer in setting out the same.

57.0. LOCALLY PROCURED MATERIALS, WORKMANSHIP, INSPECTION TESTS ETC:

57.1 QUALITY OF MATERIALS AND WORKMANSHIP:

(a) All materials and workmanship shall be of the respective kinds described in the contract and in accordance with the Engineer's instructions and shall be subjected from time to time to such tests as the Engineer may direct at the place of manufacture or fabrication or on the site or at such other place or places as may be specified in the contract or at all or any of such places.

(b) The Contractor shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any material used and shall supply samples of materials before incorporation in the works for testing as may be selected and required by the Engineer.

57.2 COST OF SAMPLES:

All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the contract, but if not then at the cost of purchaser.

57.3 COST OF TESTS:

The cost of making any test shall be borne by the Contractor, if such test is clearly intended by or provided for in the contract and, in the cases only of a test under load or of a test to ascertain whether the design of any finished or partially finished work is appropriate for the purposes which it was intended to fulfill, is particularised in the contract in sufficient details to enable the Contractor to price or allow for the same in his bid.

57.4 COST OF TESTS NOT PROVIDED FOR:

If any test is ordered by the Engineer which is either

(a) not so intended by or provided for or
(b) not so particularised or
(c) though so intended or provided for is ordered by the Engineer to be carried out by an independent person or agency at any place other than the site or the place of manufacture of fabrication of the materials tested, then the cost of such tests shall still be borne by the Contractor, if the test shows that the workmanship or materials are not in accordance with the provisions of the contract or the Engineer's instruction but otherwise by the Owner.

57.5 EXAMINATION OF WORK BEFORE COVERING UP:

No work shall be covered up or put out of view without the approval of the Engineer or the Engineer’s representative and the Contractor shall afford full opportunity for the Engineer or
the Engineer’s representative to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Engineer’s representative whenever any such work or foundation is or are ready or about to be ready for examination and the Engineer’s representative shall without delay advise the Contractor accordingly, attend for the purpose of examining and measuring such work or of examining such foundations.

57.6 UNCOVERING AND MAKING OPENINGS:

The Contractor shall uncover any part or parts of the works or make openings in or through the same as the Engineer may from time to time direct and shall reinstate and make good such part or parts to the satisfaction of the Engineer. If any such part or parts have been covered up or put out of view, after compliance with the requirement of clause No. 57.5 above, and are found to be executed in accordance with the contract, the expenses of uncovering, making openings in or through reinstating and making good of the same shall be borne by the Owner, but in all other cases, these costs shall be borne by the Contractor.

57.7 INSPECTION OF OPERATIONS:

The Engineer and any person authorized by him shall at all time have access to the works and to all workshops and places where work is being prepared or from where materials are being obtained for the works and the Contractor shall afford every facility for and every assistance in or in obtaining the right to such access.

57.8 REMOVAL OF IMPROPER WORK AND MATERIALS:

(a) The Engineer/Engineer’s representative shall during the progress of the works have power to order in writing from time to time.

(i) The removal from the site within such time or times as may be specified in the order of any materials, which in their opinion are not in accordance with the contract.

(ii) The substitution of proper and suitable materials and

(iii) The removal and proper re-execution, notwithstanding any previous tests thereof or interim payment therefore, of any work which in respect of materials or workmanship is not in accordance with the contract.

(b) In case of default on the part of the Contractor in carrying out such an order, the Owner shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Owner or may be deducted by the Owner from any amount due or which may become due to the Contractor.

58.0 COMMENCEMENT OF WORKS, PROGRAMME OF WORKS, TIME FOR COMPLETION ETC:

58.1 PROGRAMME OF WORKS:

(a) The Contractor shall on award of the contract subject to provisions in the conditions of contract submit to the Engineer for approval, a programme showing the order of procedure in which he proposes to carry out the works. The Contractor shall whenever required by the Engineer/Engineer’s representative also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the works.

(b) If at any time, it should appear to the engineer that the actual progress of works does not conform to the approved programme referred to in clause No.58.1 (a) above, the Contractor shall produce at the request of the Engineer, a revised programme showing the modifications to the approved programme necessary to ensure completion of the works within the time for completion as defined in clause No.58.3 hereof.
(c) The submission to and approval by the Engineer/Engineer’s representative of such programme(s) or furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the contract.

58.2 **COMMENCEMENT TIME AND DELAYS:**

The Contractor shall commence the works on site within the period specified in clause No. 58.1(a) and after the receipt by him of a written order to this effect from the Engineer and shall proceed with the same with due expedition and without delay, except as may be expressly sanctioned or ordered by the Engineer or be wholly beyond the contractor's control.

58.3 **TIME FOR COMPLETION:**

The firm shall complete the project within the time period specified in this tender specification/PO or any extension allowed by RSDCL.

58.4 **EXTENSION OF TIME FOR COMPLETION OF WORKS:**

Should the amount of extra or additional work of any kind or any cause of delay referred to in these conditions or other special circumstances of any kind whatsoever which may occur, other than through a default of the Contractor, be such as fairly to entitle the Contractor to an extension of time for the completion of the works, the engineer shall determine the amount of such extension and shall notify the owner and Contractor accordingly provided that the Engineer is not bound to take into account any extra or additional work or other special circumstances unless the Contractor has within twenty eight days after such work has commenced, or such circumstances have arisen, or as soon thereafter as is practicable, submitted to the Engineer's representative full and detailed particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time.

58.5 **NO NIGHT WORK OR WORK ON SUNDAYS/WEEKLY OFF AND HOLIDAYS:**

Subject to any provision to the contrary contained in the contract, none of the permanent works shall, save as hereinafter provided be carried on during the night or on Sunday or on other declared holidays or other locally recognized days of rest, except when the work is unavoidable or is absolutely necessary for the saving of life or property or for the safety of the works in which case the Contractor shall advise the Engineer’s representative accordingly and obtain written permission thereof, if necessary.

58.6 **RATE OF PROGRESS:**

If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the works or any section is at any time in the opinion of the Engineer, too slow to ensure completion by the prescribed time or extended time for completion, the Engineer shall so notify the Contractor in writing and the Contractor shall there upon take such steps as are necessary and the Engineer may approve to expedite progress so as to complete the works or such section by the prescribed time or extended time. The Contractor shall not be entitled to take additional payment for taking such steps. If, as a result of any notice given by the Engineer under this clause, the Contractor shall seek the Engineer's permission to do any work on Sundays or other holidays or other locally recognized days of rest.

58.7 **DISRUPTION OF PROGRESS:**

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

(b) If, by reason of any failure or inability of the Engineer to issue within a reasonable time in all the circumstances any drawing or order requested for by the Contractor in accordance
with clause No. 58.7(a) above, the Contractor suffered delay shall be taken into account in
determining any extension of time to which the Contractor is entitled under clause No. 58.4
above and the Contractor shall be paid the amount of such costs as shall be reasonable.

59.0 MEASUREMENT:

59.1 QUANTITIES:

The quantities set out in the bill of quantities/Bid documents are only estimated quantities
of work. They are not to be taken as the actual and correct quantities of the works to be
executed by the Contractor in fulfillment of his obligations under the contract.

59.2 WORKS TO BE MEASURED:

The Engineer shall, except as otherwise stated, ascertain and determine by measurement
the value in terms of the contract of work done in accordance with the contract. He shall,
when he requires any part or parts of the works to be measured, give notice to the
Contractor’s authorised agent or representative, who shall forthwith attend or send a
qualified agent to assist the Engineer in making such measurement and shall furnish all
particulars required by either of them. Should the Contractor not attend or neglect or omit
to send such agent, then the measurement made by the Engineer shall be taken to be the
correct measurement of the work.

60.0 TESTS ON COMPLETION:

Where possible all tests shall be carried out before shipment. Should, however, it become
necessary for the final tests as to performance and guarantees to be held over until the
plant is erected at site they shall be carried out in the presence of the Contractor's
representative within such time as may be considered reasonable by the purchaser. On the
completion of erection, should field tests indicate the equipment fails to meet guarantees,
the Contractor shall make necessary changes and corrections and assure full responsibility
and take necessary steps to ensure compliance by the equipment of the prescribed
guarantees within two (2) months from the date of notification or within such reasonable
time as may be decided by the purchaser. If however the defect is due to the Contractor, he
shall repay to the purchaser all reasonable expenses which he may be put to by such re-
tests over and above the rejection of defective plant as stated hereunder.

61.0 CERTIFICATION OF COMPLETION OF WORKS:

When the whole of the works have been substantially completed and have satisfactorily
passed any final test that is prescribed in the contract, the Contractor may give a notice to
that effect to the Engineer/Engineer representative accompanied by an undertaking to finish
any outstanding work during the period of maintenance. Such notice and undertaking shall
be in writing and shall be deemed to be a request by the Contractor for the Engineer to issue
a certificate of completion in respect of the works. The Engineer shall, within twenty one
days of the date of delivery of such notice either issue to the Contractor with a copy to the
employer, a certificate of completion stating the date on which, in his opinion, the works
were substantially completed in accordance with the contract or give instructions in writing
to the Contractor specifying all the works which, in the Engineer’s opinion, requires to be
done by the Contractor before the issue of such certificate. The Engineer shall also notify
the Contractor of any defects in the works affecting substantial completion (within twenty
one days of completion) to the satisfaction of the Engineer of the works and making good
any defects so notified.

62.0 CERTIFICATION OF COMPLETION BY STAGES:

(a) Similarly, in accordance with the procedure set out in clause No. 61.0 above, the Contractor
may request and the Engineer shall issue a certificate of completion in respect of:

(i) any section of the permanent works in respect of which a separate time for completion is
provided in the contract.
(ii) any substantial part of the permanent works which has been both completed to the satisfaction of the Engineer and occupied or used by the Employer.

(b) If any part of the permanent works shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed by the contract, the Engineer may issue a certificate of completion of the whole of the works and, upon the issue of such certificate, the Contractor shall be deemed to have undertaken to complete any outstanding work in that part of the works during the period of Maintenance.

(c) Provided always that a certificate of completion given in respect of any section or part of the permanent works, before completion of the whole, shall not be deemed to certify completion of any ground or surfaces requiring reinstatement, unless such certificate shall expressly so state.

63.0 CLIMATIC AND ISOCCERINIC CONDITIONS:

63.1 (a) The equipment offered by the supplier/contractor shall conform in all respects to the relevant Indian Standard Specifications except where stated otherwise in the order. Special care shall be taken in the design and manufacture of the Equipment to take into account the tropical conditions such as high temperature, excessive humidity, dust and salt laden atmosphere as detailed below:

(i) Maximum ambient air temperature in shade. 50°C
(ii) Minimum temperature of air in shade (-) 5°C
(iii) Maximum relative humidity 100%
(iv) Minimum relative humidity 10%
(v) Altitude above Mean sea level varies from 61M to 815M
(vi) Dust storms are liable to occur during the period from March to July.
(vii) Average No. of thunder storm days per annum 40
(viii) Average No. of tropical monsoon (condition) per annum 4 Months (June to Sep.)
(ix) Average annual Rainfall. 10cms to 100cms
(x) Mean annual temperature 32°C
(xi) Maximum wind pressure 195 Kg/Sq.m
(xii) Seismic level (Horizontal acceleration) 0.3 g
(xiii) Degree of Pollution Heavy

63.2 TROPICAL TREATMENT:

All the Equipment shall be suitably designed and treated for normal life and satisfactory operation under the Hot and hazardous tropical climatic conditions specified under clause 63.1 above shall be dust and vermin proof. All the parts and surface which are subject to corrosion shall be made of such material and shall be provided with such protective finish as would protect the Equipment installed from any injurious effect of excessive humidity.

64.0 MINOR ACCESSORIES FOR COMPLETION OF THE SUPPLY:

The Contractor shall supply all minor accessories required for the completion of supply which have either not been specifically mentioned in this specification or in Bid offer.

65.0 MATERIAL AND WORKMANSHIP:

All the Equipments shall be of best quality and capable of satisfactory operation under the climatic humid tropical conditions mentioned under clause No.63.1 above. The workmanship shall be of the highest grade and the entire manufacture shall be in accordance with the best modern Engineering practices.

66.0 ELECTRICITY ACT & REGULATIONS:

All the supplies covered by the Contract shall be in accordance with the Indian Electricity Act, 1910 with the latest amendments and the Electricity rules made there under. The contractor shall abide by all provisions of the Electricity Act, 2003, applicable CERC
regulations & amendments thereof, Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations 2007 & amendments thereof, Central Electricity Authority (Technical Standards for Construction of Electrical Plants & Electric Lines) Regulation 2010, Central Electricity Authority (Grid standard) Regulation 2010, Central Electricity Authority (Safety Requirements for construction, operation & maintenance of electrical plants & Electrical lines) Regulations 2011, Central Electricity Authority (Measures related to safety & electricity supply) Regulation 2010, Central Electricity Authority (Installation & operation of Meters) Regulations 2006, CERC (Indian Electricity Grid Code) Regulations 2010 as amended from time to time and any other applicable Standards/Regulations.

67.0 SITE TESTS:

RSDCL reserves the right to carry out any site tests which it may decide upon at its own expenses. In case the material is not found as per Purchase order, all expenses incurred during the site testing will be to supplier's account and the material shall be replaced by supplier at site, free of cost.

68.0 AFTER SALES SERVICE:

The material supplied against this order shall be attended by the Contractor at his cost within the Guarantee period. The contractor/supplier will ensure the after sales services for the supplied items/equipments beyond guarantee period also.

69.0 LATENT DEFECTS:

Any material or part thereof that develops defects not disclosed prior to the final acceptance by the Purchaser but are disclosed within one year after the material is placed in service shall be promptly replaced by supplier free of charge and all expenses, for the transportation and other incidental charges for such replacements shall be borne by the supplier.

70.0 IMPORT LICENSE:

Unless otherwise indicated or specifically agreed upon, the RSDCL will not make available the foreign exchange or Import license, if any, required by the supplier for the procurement of material or raw material required for the manufacture of the material/Equipment or part thereof to be supplied against this Specification/Contract.

71.0 CHANGE OF NAME OF THE BIDDER/SUPPLIER:

(a) At any stage after Biding, the Purchaser shall deal with the Supplier only in the name and at the address under which he has submitted Bid. All the liabilities/responsibilities for due execution of the Contract shall be that of the Supplier and in no circumstance, he shall be relieved of any obligations under the Contract. The RSDCL may, however, at his discretion deal with the, Agents/Representatives/Distributors/Manufacturers/Associates/ Principals/ Sister concerns and such dealings shall not absolve the Supplier/contractor from his responsibilities/ obligations/ liabilities to the RSDCL under the contract.

(b) Any change/Alteration of name / Constitution / Organisation of the Supplier shall be duly notified to the Purchaser and the Purchaser reserves the right to determine the Contract, in case of any such Notification. In the event of such determination, the Purchaser may affect the purchase of material not supplied from elsewhere at the risk and cost of the Bidder/Supplier.

72.0 BANKRUPTCY:

If the Contractor shall die or dissolve or commit any act of bankruptcy or being a Corporation commence to be wound up except for reconstruction purpose of carry on its business under a receiver, the executors successors or other representative in law of the state of the Contractor or any such receiver, liquidator, or any person in whom the Contract may become vested, shall forthwith give notice thereof in writing to the purchaser and shall
for one (1) month during which he shall take all reasonable steps responsible to prevent stoppage of the works, have the option of carrying out the contract subject to his or their providing such guarantee, as may be required by the Purchaser but not exceeding the value of the work for the time being remaining as un-executed, provided however, that nothing above said shall be deemed to relieve the Contractor or his successors of his or their obligations under the contract under any circumstances. In the event of stoppage of the works, the period of the option under this clause shall be fourteen (14) days only. Provided that, should the above option not be exercised, the Contract may be determined by the purchaser by notice in writing to the Contractor and it shall be lawful for the Purchaser to take the work full or in part out of the Contractor’s hands and re-contract at reasonable prices with any other persons and the Purchaser shall be entitled to retain and supply any balance which may be otherwise due on the Contract by him to the Contractor, or such part thereof as may be necessary to the payment of the cost of executing such work as aforesaid.
RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LIMITED

PART-III

SPECIAL CONDITIONS OF CONTRACT

(SCC)

FOR

CONSTRUCTION OF 4 NOS. 220/33KV PARK POOLING SUB-STATIONS

AT NOKH, JAISALMER (RAJ.)

No. RSDCL/D(T)/SP/Nokh/PPS/TK/ TN-03 (2019-20)
PART-III

SPECIAL CONDITIONS OF CONTRACT (SCC)

1.0 GENERAL INFORMATION

1.1 Rajasthan Solarpark Development Company Ltd. has envisaged to carry out the construction of four 220kV Park Pooling Sub-stations (No. 1 to 4) in Nokh Solar Park at village-Nokh, Tehsil-Pokaran, Distt. Jaisalmer (Raj).

1.2 The requirement, terms & conditions etc stated in this specification shall apply to and shall be considered as part of this Volume as if bound together. In case of any discrepancy between the provisions of this volume and other volumes, the provisions of this volume shall prevail.

1.3 Unless brought out clearly, the bidder shall be deemed to confirm strictly to bid documents. All deviations from the specifications shall be clearly brought out in respective schedule of deviations (Schedule-V of Volume-I). Any discrepancy between specification and bid if not clearly brought out in the schedule, will not be considered as a valid deviation.

1.4 The bidder shall quote for the complete scope of works covered under the bidding document. The evaluation will be made accordingly. A bid not comprising the complete scope of works as specified in the specification will be liable for rejection.

2.0 BID GUARANTEE (EMD)

2.1 For the purpose of Clause No. 23.0 (bid security), Section ITB, Volume-I, the bid security shall be furnished in two parts as under:

(a) Rs. 96,76,000 only (Rupees Ninety Six Lakhs Seventy Six Thousand only) shall be furnished through Demand Draft/Banker’s Cheque drawn in favour of MD, RSDCL, Jaipur or deposited in cash.

(b) Rs. 3,87,04,000 only (Rupees Three Crore Eighty Seven Lakhs Four Thousand only) shall be furnished in the form of Bank Guarantee, initially valid for a period of 180 days with a grace period of 90 (ninety) days for which proforma has been enclosed at Annexure-VIII, Volume-I.

All the participating firms including Central & State Govt. undertakings/ corporations and Companies are also to submit Bid Security (EMD) with the bid as above.

3.0 QUALIFYING REQUIREMENTS:

3.1 The Qualifying Requirements for the Bidders are given in Clause No. 2.0 of “Instructions to the bidder”.

4.0 CERTIFICATE REGARDING ACCEPTANCE OF IMPORTANT CONDITIONS

4.1 It is brought to the specific notice of bidders that they are not permitted to take deviations to the following conditions:

(a) Terms of Payment: Clause 34.0 Section GCC, Volume-I and Clause 7.0 & 9.0 of Special Conditions of Contract.

(b) Bid Security: Clause 23.0, Section ITB Volume-I and clause 2.0 of Special Conditions of Contract.

(c) Contract Performance & Security Guarantees: Clause 40.0 & 41.0 respectively, Section ITB, Volume-I & Clause 32.0, Section GCC, Volume-I

(d) Delay in delivery/ completion: Clause 14.0, Section GCC, Volume-I and Clause 12.0 of Special Conditions of Contract.
5.0 BID PRICE

The bidders shall quote the prices in the appropriate Price schedules (i.e. BoQ1 to BoQ4) for the entire scope of works (covered under the specification, bidding document) as per details indicated in Clause No. 12.0 ITB.

6.0 COMPARISION OF BIDS

6.1 The Bids of only sort listed bidders shall be compared on the basis of total evaluated package price of all four Park Pooling Sub-stations (i.e. for supply portion and for services to be rendered as quoted by the bidders in respect of supply, erection, testing, commissioning and Civil works as well as charges for Handholding and percentage rebate offered, if any). The loading of quoted Transformers and Reactors losses shall also be done for price evaluation. For comparison purposes, the entire evaluated bid price shall be in Indian Rupees.

6.2 All evaluated bid package price (for all 4 Pooling Sub-stations) of the eligible (sort listed) bidders shall be compared among themselves to determine the lowest evaluated bid and as result of this comparison, the lowest bid will be selected for the Award of the Contract.

6.3 Any conditional discount offered by the bidder shall not be taken into consideration for evaluation.

6.4 Bids for individual equipment or incomplete services shall be treated as incomplete and are liable to be rejected.

7.0 TERMS OF PAYMENT

7.1 The payments for the material/ equipment or erection work shall be made as under only after execution of the Contract Agreement (CA) and furnishing of Security Bank Guarantee of 2% of total contract value (valid up to 90 days from the date of handing over of all the Pooling Sub-stations after commissioning), Performance Bank Guarantee of 10% of total contract value (valid up to one year from the date of handing over of all the Pooling Sub-stations) and Project Implementation Schedule (L-2 Network) and its approval as per the following relevant clauses.

All payments shall be made in accordance to Clause 34.3 of GCC from the date of submission of duly verified bills & completion of all contractual formalities as per requirement of contract.

7.1.1 No interest on delayed payments, if any, shall be payable by RSDCL.

7.2 FOR SUPPLY OF GOODS (MATERIAL/EQUIPMENT):

The terms of payment shall be as indicated in Cl. No.34.7 of GCC and 15.0 of ITB Vol.-I.

7.3 TAXES AND DUTIES:

The terms& conditions of taxes, duties shall be as indicated in Clause No. 34.7.4 & 34.7.7 of GCC and Clause No. 15.0 of ITB Volume-I.

7.4 TYPE TEST CHARGES:

The type tests shall be conducted as per requirement of specification Volume-II & submitted by the bidder from a Govt./Govt. approved/Govt. recognized/NABL accredited test lab/ILAC i.e. International Laboratory Accreditation Co-operation (in case of foreign laboratories) or the certificates of type tests conducted at manufacturer’s works duly witnessed by representative of any Electricity Board or Nigam/Govt. Agency/PGCIL/CPRI/NTPC (wherever specified in technical specification for particular item) or the certificates of type tests conducted in the manufacturer’s own lab located in the foreign Country duly witnessed by independent agency.
as per relevant standards. The type test certificates should not be older than 7 years as on the date of technical bid opening for which the date of conducting of test will be considered. However, no separate type test charges shall be paid to the bidders.

8.0 PRICE ADJUSTMENT DUE TO PRICE VARIATION: Not applicable.

9.0 MODE OF PAYMENT

9.1 Payment shall be made promptly by the owner within a reasonable period of receipt of the Contractor’s Tax invoice, complete in all respect and supported by the requisite documents, if any. All the payment shall be released to the contractor directly. No interest shall be payable, if payments are made after stipulated period.

Payment shall be made to supplier/contractor through RTGS/NEFT for quick and safe transfer of funds across the country (both local and outstation). The charges for transfer through RTGS/NEFT shall be on the part of supplier/contractor. The supplier/contractor shall furnish particulars to the payment making authorities of RSDCL in prescribed format to be provided by the purchaser.

10.0 TIME SCHEDULE

For the purpose of Clause No. 17.0 of ITB, the schedule for completion of supply of material/equipment, successful erection, testing, commissioning & execution of Civil Works of all four 220/33kV Park Pooling Sub-stations and their handing over to RSDCL, complete in all respect as per specification of entire work shall be 15 (Fifteen) months from the date of issue of detailed purchase/work order(s). The completion period is inclusive of monsoon period also.

The contractor will immediately mobilize its resources for development of shop, sketches and proto assembly of structures (if required), selection of vendors for other works, material/equipments, placing orders on them and opening of site offices etc. accordingly.

11.0 QUANTITY VARIATION FOR SUBSTATION:

RSDCL reserves the right to increase or decrease the quantity of Goods and Services for the items for which quantities have been indicated by the Owner and included in the Letter of Award, without any change in unit price or other terms and conditions, during the execution of Contract. The quantities of individual items may vary upto any extent without any change in unit price or other terms &conditions.

12.0 DELAY IN DELIVERY/COMPLETION:

12.1 The time and the date of delivery/completion period specified in the purchase/work order shall be deemed to be the essence of the contract and the works of all four Pooling Sub-stations shall have to be completed not later than the period specified in the specification or any extension thereof. Should the contractor fail to complete the work (including testing and commissioning and civil works) of Pooling Sub-stations on order or any part thereof within the specified completion period, the contractor shall pay recovery to the owner towards delay in completion of Pooling Sub-stations, a sum equivalent to half percent (0.5%) of the total contract price (i.e. material, erection & civil works including handholding charges) as a recovery for such default for each week or part thereof of delay, until actual completion, upto a maximum recovery of 10% of the total contract price (material, erection & civil works including handholding charges). The payment or deduction of such recovery shall not relieve the contractor from its obligation to complete the works or any other obligations and liabilities under the contract.

12.2 Any financial liability arising from and consequent upon the failure of the contractor to adhere to the stipulated completion schedule shall be to the contractor’s account.

Note: Contract price shall mean “Ex-works price of material/equipments including freight, insurance, taxes & duties and total cost of erection, testing, commissioning & civil works and handholding charges of all sub-stations”.

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13.0 FUNCTIONAL GUARANTEES, RECOVERY FOR NON-PERFORMANCE:

13.1 The bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipments covered in this specification. The bidder shall also furnish a declaration and details in the manner prescribed in the relevant schedule of Bid Proposal Sheet for guarantees which shall attract recovery for non-performance as given below:

13.2 If the guarantees are not established at factory tests or during site testing then the RSDCL at its discretion may reject or accept the equipment after assessing the recovery as per Clause 13.3 below against the Contractor and such amounts shall be deducted from the Contract Price or otherwise recovered from the Contractor.

13.3 PENALTIES FOR EXCESS LOSSES OF POWER TRANSFORMERS:

In case of transformers, if during inspection at manufacturer’s works or during site testing, the measured values of ‘No load’ & ‘Load’ losses are found more than the guaranteed required values of ‘No load’ & ‘Load’ losses indicated in technical specification, the penalty shall be calculated @Rs. 3,32,000.00 per KW for the excess of ‘No load’ losses and @Rs.1,36,000.00 per KW for the excess of difference in total losses & ‘No load’ losses. For fraction of Kilowatts, penalty shall be applicable on prorata.

13.4 The amount of recovery so recoverable shall be without any ceiling and shall not prejudice the Contractor’s other liabilities under the Contract in any manner. The recoveries for shortfall in guaranteed parameters and for delay in completion are independent of each other and shall be levied separately and concurrently.

14.0 HANDHOLDING REQUIREMENT:

Immediately after the handing over of the Pooling Sub-stations, the successful bidder shall place his atleast 3 (three) Nos. expert Engineers at each Pooling Sub-station for 12 months period who can handle the initial operational problems and shall run the Sub-stations along with the RSDCL/other Engineers. They shall also simultaneously train RSDCL Engineers or Engineers nominated by RSDCL on total aspect of the system installed at Pooling Sub-stations. The Engineers posted by the firm should remain available round the clock on the Pooling Sub-stations.

15.0 ERECTION INSURANCE:

In addition to conditions specified in Clause 38.0, Section-GCC, Volume-I & Clause 28.0, Section-ECC, following shall also apply:

15.1 STORAGE CUM WORKS INSURANCE:

(a) The Contractor, at his own cost shall take necessary insurance against loss, damage, theft, pilferage, fire, accident and damages during transit from stores to site for all the materials/goods belonging to him (supplied by him) for the purpose of execution of work. The insurance shall also cover for loss, damage, accidents occasioned by the Contractor in the course of operation carried out by him for the purpose of complying with his contractual obligations thereof. The insurance shall be from the General Insurance Corporation of India or any other Nationalized Insurance Company, which shall cover the entire cost of materials, erection & commissioning and civil works portion on comprehensive basis during the entire period of contract.

(b) The insurance shall be in the joint names of RSDCL and the Contractor so that the RSDCL and the Contractor are covered for the entire period of contract from the commencement of the contract till handing over all the works completed in all respects to the engineer.

(c) All the equipment and materials (including structures foundations) being supplied by the Contractor shall be kept completely insured by the Contractor at his cost against loss, damage, theft, pilferage, fire etc. from the time of dispatch from the Contractor’s/his
vendor’s or sub-vendor’s works, upto the completion of erection, final checking, testing and commissioning at site and taking over of the sub-stations by the RSDCL.

(d) It will be the responsibility of the Contractor to lodge, pursue and settle all claims (for all the equipments and materials) with the insurance company in case of any damage, loss, theft pilferage or fire etc. and the RSDCL shall be kept informed about it. The Contractor shall replace the lost/damaged materials promptly irrespective of the settlement of the claims by the underwriters and ensure that the work progress is as per agreed schedules. The losses, if any, in such replacement will have to be borne by the Contractor, if the claims are not lodged and perused properly in time or if the same are not settled by the insurance company.

15.2 The Insurance policies to be furnished by the bidder and shall also ensure that:

(i) Insurance premium should be one time paid.

(ii) Deductible franchise should be minimum as per insurance rules. In case of any loss to the extent of deductible franchise, the same shall be borne by the bidder.

(iii) The insurance should be valid from the date of start of work and shall remain valid up to 30 days from the date of handing over of the sub-stations & bays to the Engineer-in-charge.

(iv) Computerized and stamped insurance policy shall be furnished by the bidder to the Director (Technical) RSDCL, Jaipur for his acceptance. Insurance cover Note shall not be acceptable.

(v) In case of any dispute, the jurisdiction of Courts shall be subject to the courts of Law at Jaipur (Rajasthan) only. Such provision of jurisdiction shall be incorporated by the Contractor in the insurance policy.

15.3 THIRD PARTY INSURANCE:

The Contractor shall, if and so far as the contract provides, indemnify the COMPANY against all losses and claims in respect of injury or damage to property what-so-ever while these arise out of or in consequences of the execution of works and against all claims proceedings, damages, costs, charges, expenses what-so-ever in respect of or in relation thereto. Accordingly the Contractor shall before commencement of execution of the works insure against his liability for material or physical damage, loss or injury which may occur to property including that of the COMPANY, or to any person including any employee of the COMPANY, by or arising out of the execution of the works in carrying out of the contract.

15.4 REMEDY ON CONTRACTOR’S FAILURE TO INSURANCE:

If the Contractor shall fail to effect and keep in force insurance referred to in clause 38 of GCC, 28 of ECC and 15.1 & 15.3 above thereof or any other insurance which he may be required to effect under the terms of contract then the COMPANY may effect and keep in force any such insurance and pay such premium(s) as may be necessary for that purpose and from time to time deduct the amount so paid by the COMPANY as aforesaid from any money due or which may become due to the Contractor or recover the same as debt from the Contractor.

16.0 INDEMNITY BOND:

For the sub-station material to be provided by the Contractor, it will be the responsibility of the Contractor to take delivery, unload and store the materials at site and execute trust receipt and obtaining authorization letter from RSDCL as per proforma at Annexure-VI & VII and an indemnity bond in favour of RSDCL against loss, damage and any risks involved for the full value of the materials. This indemnity bond shall be furnished by the Contractor to the sub-station incharge for his acceptance before commencement of the supplies and shall
be valid till the scheduled date of testing, commissioning and handing over of the sub-stations and bays to the Engineer.

17.0 SURPLUS MATERIALS

17.1 On completion of the works, all surplus material, equipments supplied by the contractor at site against construction of 220kV Pooling Sub-stations, if not required by the RSDCL, shall be lifted by the contractor at his own expenses and cost. RSDCL shall not be insisted upon by the contractor for taking over of the surplus material/equipments supplied, if not required by the RSDCL. Excess payments released, if any towards surplus material/equipments to the contractor shall be recovered by the RSDCL from the contractor. Surplus material/equipment shall be lifted back by the contractor after recovery of payment released, if any, towards surplus material/equipment by the RSDCL.

18.0 POWER, WATER & COMMUNICATION:

The Contractor shall make his own arrangements for power, water and other facilities necessary for the construction/erection of Pooling Sub-stations at his own cost.

19.0 LAND FOR CONTRACTOR’S OFFICE, STORE WORKSHOP ETC:

The land for construction of his field office, workshop, Stores etc. in isolated locations, assembling yard etc. as required for execution of the Contract shall be provided by RSDCL, if available.

20.0 REGISTERED OFFICE ADDRESS OF OWNER:

E-166, Yudhishthir Marg, C-Scheme, Rajasthan Solarpark Development Company Ltd., Jaipur-302001 (Raj.).
RAJASTHAN SOLARPARK DEVELOPMENT COMPANY LIMITED

PART-IV

ERECTION CONDITIONS OF CONTRACT

(ECC)

FOR

CONSTRUCTION OF 4 NOS. 220/33KV PARK POOLING SUB-STATIONS

AT NOKH, JAISALMER (RAJ.)

No. RSDCL/D(T)/SP/Nokh/PPS/TK/ TN-03(2019-20)
PART-IV

ERECITION CONDITIONS OF CONTRACT (ECC)

1.0 GENERAL

1.1 The following shall supplement the conditions already contained in the other parts of these specifications and document and shall govern the portion of the works of this Contract to be performed at Site.

1.2 The Contractor, upon signing of the Contract shall, in addition to a project Co-ordinator, nominate another Responsible Engineer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at Site. Such person shall function from the Site office of the Contractor during the pendency of Contract.

2.0 REGULATION OF LOCAL AUTHORITIES AND STATUTES

2.1 The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948 and the Payment of Wages Act (both of the Govt. of India) and the rules made there under in respect of any employee or workman employed or engaged by him or his Sub-Contractor.

2.2 All registration and statutory inspection fees, if any, in respect of his work pursuant to this contract shall be to the account of the Contractor. Only the registration statutory inspection fees such as inspection fees of the Sr. Electrical Inspector & registration fees payable under the Factory Act for the sub-stations, lawfully payable under any statutory laws and its amendments from time to time during erection in respect of the equipment ultimately to be owned by the RSDCL, shall be to the account of RSDCL. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his sub Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.

3.0 OWNER’S LIEN ON EQUIPMENT

The Owner shall have lien on all equipment including those of the Contractor brought to the Site for the purpose of erection, testing and commissioning of the equipment to be supplied & erected under the Contract. The Owner shall continue to hold the lien on all such equipment throughout the period of contract. No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Engineer.

4.0 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled Inspection, Testing and Inspection Certificates under Technical Specification; section GTC shall also be applicable to the erection portion of the Works. The RSDCL Engineer(s) shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor’s works, before and after the same are erected at Site. If by the above inspection, the RSDCL Engineer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/repairs as may be necessary to the satisfaction of RSDCL Engineer. Such replacements will also include the replacements or re-execution of such of those works of other contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor’s works.

5.0 ACCESS TO SITE AND WORKS ON SITE

5.1 Suitable access to and possession of the Site shall be accorded to the Contractor by the RSDCL in reasonable time.
5.2 The works so far as it is carried out on the Owner's premises, shall be carried out at such time as the Owner may approve and the Owner shall give the contractor reasonable facilities for carrying-out the works.

5.3 In the execution of the works, no person other than the Contractor or his duly appointed representative, approved Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing of the Engineer or his representative.

6.0 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor shall establish Site Office at the working sites and keep posted an authorized representative (Engineer) for the purpose of the Contract. Any written order or instruction of the RSDCL Engineer or his duly authorized representative shall be communicated to the said authorized resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

7.0 CO-OPERATION WITH OTHER CONTRACTORS

7.1 The Contractor shall co-operate with all other Contractors or tradesmen of the Owner, who may be performing other works on behalf of the owner and the workmen who may be employed by the Owner and doing work in the vicinity of the Works under the Contract. The Contractor shall also so arrange to perform his work as to minimize, to the maximum extent possible, interference with the work of other Contractors and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good at the Contractor's own expense. The Engineer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of any acts of omission of another Contractor, the Contractor shall have no claim against the Owner on that account other than an extension of time for completing his Works.

7.2 The Engineer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Engineer shall determine the corrective measures if any, required rectifying this situation after inspection of the works and such decisions by the Engineer shall be binding on the Contractor.

8.0 DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Engineer in respect of his employees and work-men at Site. The Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site. If in the opinion of the Engineer such employee has mis-conducted himself or is incompetent or negligent or otherwise undesirable, then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

9.0 CONTRACTOR'S FIELD OPERATION

9.1 The Contractor shall keep the Engineer informed in advance regarding his monthly field activity plans and schedules for carrying-out each part of the works. Any review of such plan or schedule or method of work by the Engineer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Engineer or the Owner or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

9.2 The Contractor shall have the complete responsibility for the conditions of the Work-site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal
working hours. The construction review by the Engineer is not intended to include review of Contractor’s safety measures in, on or near the worksite, and their adequacy or otherwise.

10.0 PHOTOGRAPHS AND PROGRESS REPORT

10.1 The Contractor shall furnish three (3) prints each to the owner and to Site Engineer, RSDCL of progress photographs of the work done at Site. Photographs shall be taken every month or as and when indicated by the Engineer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.

10.2 The above photographs shall accompany the monthly progress report detailing-out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.

11.0 MAN-POWER REPORT

11.1 The contractor shall submit to the Engineer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area wise.

11.2 The Contractor shall also submit to the Engineer, on the first day of every month a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill wise and the areas of employment of such labour.

12.0 PROTECTION OF WORK

The Contractor shall have total responsibility for protecting his works till it is finally taken over by the RSDCL Engineer. No claim will be entertained by the Owner or by the Engineer for any damage or loss to the contractor’s works and the contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawing. Should any such damage to the contractor’s works occur because of any other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the contractor’s works, the same shall be resolved as per the provisions of the Clause 7.0 above entitled “Cooperation with other Contractors”. The Contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such dispute. The Contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.

13.0 EMPLOYMENT OF LABOUR

13.1 The Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.

13.2 All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor’s employees shall be the sole responsibility of the Contractor.

13.3 The hours of work at Site shall be decided by RSDCL and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day i.e. from Monday to Saturday (incase, the weekly off is kept on Sunday).

13.4 The Contractor’s employees shall wear identification badges while on work at Site.

13.5 Incase, the Owner becomes liable to pay any wages or dues to the labour or any Govt. agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the
Contractor, the Owner may make such payments and shall recover the same from the Contractor’s bills.

13.6 The contractor must have a separate registration of EPF with the RPFC. The contractor shall have to submit an aertificate that he has an establishment covered under the provisions of Employees Provident Fund (EPF) Act-1952 & having a separate Registration number with provident fund commissioner. In absence of the same, the contractor shall be liable to deposit employees as well as employer’s contribution (in respect of employees engaged by him for the said work) with RSDCL along with details of such employees and deductions thereof as per RSDCL CPF rules. In case of failure of contractor to do so, RSDCL shall be entitled to deduct the amount from his bill (s)/security etc.

14.0 FACILITIES TO BE PROVIDED BY RSDCL:

14.1 SPACE: Land for Contractor’s Office, Store, Workshop etc. at sites.

(a) The Engineer shall at his discretion and for the duration of execution of the Contract make available at site, land for construction of Contractor’s field office, work-shop, stores, magazines for explosives in isolated locations, assembling yard, etc. required for execution of the contract. Any construction of temporary roads, offices, workshop, etc. as per plan approved by the Engineer shall be done by the Contractor at his cost. The above land shall be made available on a rent free basis for the period of execution of works of substations.

(b) On completion of work the Contractor shall hand over the land duly cleaned to the Engineer until and unless the Contractor has handed over the vacant possession of land allotted to him for the above purpose, the payment of his final bill shall not be made. The contractor shall be made liable to pay for the use and occupation at the rates to be determined by the Engineer if the Contractor over stays in the land after the Contract is completed.

14.2 ELECTRICITY/POWER SUPPLY:

At present, the power supply is not available with the RSDCL for construction purposes at site. The contractor shall have to make the power supply arrangements for construction purposes for which, if so desired by him, he may apply to the local DISCOM Company (VVNL) for the power supply connection. The expenses for obtaining the connection and payment towards consumption of electricity as per billing by the DISCOM Company shall be borne by the contractor. The Electricity provided will be of 440 Volts, 3-phase, 50 cycles and 230 Volts, 1 phase, 50 cycles. The Contractor shall provide and install all necessary transformers, switchgear, wiring fixtures, bulbs and other temporary equipment for further distribution and utilization of energy for power and lighting and shall remove the same on completion of the work. Should, however, electricity be used in the Contractor’s labour/staff colony, the power so consumed shall be charged at the prevailing tariff rate by DISCOMs as prevalent for that area from time to time. The supply may be withdrawn, if the power is used for purposes other than for the work of the project and the Contractor shall not be entitled to any claim whatsoever on account of any such action taken by the Engineer/Discom.

14.3 WATER:

Supply of water, wherever available with the RSDCL, may be made available for the construction purposes at the prevailing rates and the same shall be given at an agreed single point at the site. Any further distribution will be the responsibility of the Contractor. Drinking water, if available will also be provided at one agreed point at the site at the prevailing rates. Further, distribution either to his labour colony or his work site or to his office shall be the responsibility of the Contractor. Where the water is not available with the RSDCL, the contractor shall have to make his own arrangements both for the construction & drinking purposes.

15.0 FACILITIES TO BE PROVIDED BY THE CONTRACTOR:
15.1 TOOLS, TACKLES AND SCAFFOLDINGS
The Contractor shall provide all the construction equipment, tools, tackles and scaffoldings required for the telephone, pre-assembly, erection, testing and commissioning of the equipments covered under the Contract. He shall submit a list of all such materials to the Engineer incharge before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Engineer.

15.2 COMMUNICATION
The contractor will make his own arrangements for the telephone, telex & fax facilities at site for purpose of contract. The contractor shall be responsible for the payment towards the use of such facilities to the concerned Companies.

15.3 FIRST AID
The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Sufficient number of Contractor’s trained personnel shall be arranged by the contractor the administering first aid at site.

15.4 CLEANLINESS
15.4.1 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Engineer. Materials and Stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface a suitable protective cover of a flame resistant oil proof sheet shall be provided to protect the floor from such damage.

15.4.2 Similarly, the labour colony, offices and the residential areas of the Contractor’s employees and workmen shall be kept clean and neat to the entire satisfaction of the Engineer. Proper sanitary arrangements shall be provided by the Contractor in the work-areas, office and residential areas of the Contractor.

16.0 LINES AND GRADES
All the works shall be performed to the lines grades & elevations indicated on the drawings. The Contractor shall be responsible to locate and lay-out the works. Basic horizontal and vertical control points will be established and marked at site at suitable points and got approved from the Engineer. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Engineer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points as may be established are checked by the Engineer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Engineer at Contractor’s expense.

17.0 FIRE PROTECTION
17.1 The work procedures that are to be used during the erection shall be those which minimize fire hazardsto theextent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or inflammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Un-treated materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

17.2 Similarly, corrugated paper fabricated cartons etc will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc.
which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

17.3 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

17.4 The Contractor shall provide sufficient number of fire protection equipment of the type specified for the ware-houses, office, temporary structures, labour colony, stores, oil storage etc. Access to stores, oil storage & such fire protection equipment shall be easy and kept open at all time.

18.0 SECURITY

The Contractor shall have total responsibility for all equipment and materials in his custody/stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all material, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the project Site only with the written permission of the Engineer in the prescribed manner.

19.0 CONTRACTOR’S AREA LIMITS

The Engineer will mark out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor’s personnel to work out of the areas marked out for him, the same shall be done only with the written permission of the Engineer.

20.0 CONTRACTOR’S CO-OPERATION WITH THE OWNER

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Owner, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Engineer and the same shall be acceptable at all times to the Contractor. The Engineer may impose such restrictions on the facilities provided to the Contractor such as electricity, water etc. as he may think fit in the interest of the Owner and the Contractor shall strictly adhere to such restrictions and co-operate with the Engineer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in the document and specification.

21.0 PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS

The pre-commissioning trials and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical specification, section GTC. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these trials. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such trials.

22.0 MATERIALS HANDLING AND STORAGE

22.1 All the equipment furnished under the Contract and arriving at Site shall be promptly received, unloaded, transported and stored in the Storage spaces by the Contractor.

22.2 Contractor shall be responsible for examining all the shipment and notify the Engineer immediately of any damage, shortage, discrepancy etc. for the purpose of Engineer's
The Contractor shall submit to the Engineer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

22.3 The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Engineer-in-charge.

22.4 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Engineer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.

22.5 All electrical equipments, devices, panels, control gears, motors and such other devices shall be properly dried if required before they are installed and energized. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected.

22.6 All the electrical equipment shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Engineer.

22.7 The Contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before the equipment are installed.

22.8 The Consumable and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

22.9 All the material stored in the open or dusty location must be covered with suitable weather-proof and flame proof covering material wherever applicable.

22.10 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Engineer will have the right to get it moved to the area earmarked for the Contractor at the Contractor’s cost.

22.11 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Engineer, in addition, may direct the Contractor to move certain other materials which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.

23.0 CONSTRUCTION MANAGEMENT

23.1 The field activities of the Contractors working at Site will be coordinated by the Engineer and the Engineer’s decision shall be final in resolving any disputes or conflicts between the contractor and other Contractors and tradesmen of the Owner regarding scheduling and coordination of work. Such decision by the Engineer shall not be a cause for extra compensation or extension of time for the Contractor.

23.2 The Engineer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decision of the Engineer and shall strictly adhere to those decisions in performing his works. In addition to the above weekly
meeting, the Engineer may call for other meeting either with individual contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.

23.3 Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Engineer, satisfying him that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

23.4 The Engineer shall, however, not be responsible for providing additional labour and/or materials or supply or any other services to the Contractor except for the Coordination work between various Contractors as set out earlier.

24.0 FIELD OFFICE RECORDS

The contractor shall maintain at his site office upto-date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and engineering data shall be submitted to the Engineer in required number of copies.

25.0 CONTRACTOR’S MATERIALS BROUGHT ON TO SITE

25.1 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools & tackles for the purpose of the works under intimation to the Engineer. All such goods shall from the time of their being brought vest in the RSDCL, but may be used for the purpose of the works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Engineer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereto and damage thereto.

25.2 The RSDCL shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the RSDCL shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sum due as aforesaid.

25.3 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Engineer, the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Engineer. If the Contractor fails to remove such materials within fifteen (15) days of issue of a notice by the Engineer to do so then the Engineer shall have the liberty to dispose off such materials as detailed under clause 25.2 above and credit the proceeds thereto to the account of the Contractor.

26.0 PROTECTION OF PROPERTY AND CONTRACTOR’S LIABILITY

26.1 The Contractor shall be responsible for any damages resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the RSDCL and the employees of other contractors and Sub-contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

26.2 The Contractor will ensure provision of necessary safety equipment such as barriers, signboards, warning lights and alarms etc to provide adequate protection to persons and
property. The Contractor shall be responsible to give reasonable notice to the Engineer and the RSDCL of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his works and shall make all necessary arrangements with such owners, related to removal and/or replacement or protection of such property and utilities.

27.0 PAINTING

All exposed metal parts of the equipment including piping, structures, railing etc. wherever applicable, after installation unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust scales, grease, oil and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the Engineer for painting. Afterwards, the above parts shall be finished painted with two coats of allowed resin machinery enamel paints. The Quality of the finish paint shall be as per the standards of ISI or equivalent and shall be of the colour as approved by the Engineer.

28.0 INSURANCE

28.1 In addition to the conditions covered under the Clause entitled "Insurance" in General Terms and Conditions of Contract of this Volume-I, the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing works.

28.2 WORKMEN’S COMPENSATION INSURANCE

This insurance shall protect the Contractor against all claims applicable under the Workmen’s Compensation Act, 1948 (Govt. of India). This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his Sub-Contractor's employee, which for any reason are not covered under the Workmen’s Compensation Act, 1948. The liabilities shall not be less than:

Workmen’s Compensation: As per statutory Provisions.
Employee’s liability: As per statutory provisions.

28.3 COMPREHENSIVE AUTOMOBILE INSURANCE

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the RSDCL's men at site and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the ownership of such vehicles. The liability covered shall be as here in indicated:

(a) Fatal Injury: Rs. 1,00,000 each person.
(b) Rs. 2,00,000 each occurrence.
(c) Property Damage: Rs. 100,000 each occurrence.

28.4 COMPREHENSIVE GENERAL LIABILITY INSURANCE

28.4.1 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents his employees, his representatives and Sub-contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled Defence of Suits under General Terms & Conditions of Contract of this Volume-I.

28.4.2 The hazards to be covered will pertain to all the works and areas where the Contractor, his Sub-contractors, his agents and his employees have to perform work pursuant to the Contract.
28.5 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractors to maintain all necessary insurance coverage to the extent both in time and amount to take care of all is liabilities either direct or indirect, in pursuance of the contract and during the contract period till the work is handed over to the owner.

29.0 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effect during inclement weather conditions, like monsoon, storms etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the Concurrence of the Engineer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the Schedule.

30.0 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his works either during excavation or elsewhere are properly protected and handed over to the Engineer of RSDCL. Similarly, the Contractor shall ensure that the bench marks, reference points etc., which are marked either with the help of Engineer or by the Engineer shall not be disturbed in any way during the performance of his works. If, any work is to be performed which disturbs such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Engineer of RSDCL. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

31.0 WORK & SAFETY REGULATIONS

31.1 The Contractor shall ensure proper safety of all the workmen, materials plant and equipments belonging to him or to RSDCL or to others, working at the Site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the Engineer as he may deem necessary.

31.2 The Contractor will notify well in advance to the Engineer of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Engineer shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contractor shall strictly adhere to and comply with such instructions. The Engineer shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Owner and the Owner shall not entertain any claim of the Contractor towards additionalsafety provisions/conditions to be provided for/constructed as per the Engineer's instructions.

Further, any such decision of the Engineer shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the site area is forbidden by the Engineer, the Contractor shall use alternative methods with the approval of the Engineer without any cost implication to RSDCL or extension of work schedule.

31.3 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the contractor shall be responsible for carrying-out such provision and/or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act, 1948 and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.
31.4 All equipment used in Construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the Contractor in accordance with manufacturer’s operation Manual and safety instructions and as per Guideline/Rules of RSDCL in this regard.

31.5 Periodical Examinations of all lifting/hoisting equipment & tackles shall be carried-out in accordance with the relevant provisions of Factories Act-1948, Indian Electricity Act-1910 and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by Engineer or by the person authorized by him.

31.6 The Contractor shall be fully responsible for the safe storage of his and his sub-contractor’s radio-active sources in accordance with BARC/DAE Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, storage and handling of such material will be taken by Contractor.

31.7 The Contractor shall provide suitable safety equipment of prescribed standard to all employees and workmen according to the need, as may be directed by Engineer who will also have right to examine these safety equipment to determine their suitability, reliability, acceptability and adaptability.

31.8 Where explosives are to be used, the same shall be used under the direct control and Supervision of an expert, experienced, qualified and competent person strictly in accordance with the Code of Practices/Rules framed under Indian Explosives Act pertaining to handling, storage and use of explosives.

31.9 The Contractor shall provide safe working conditions to all workmen and employees at the Site including safe means of access, railings, stairs, ladders, scaffoldings etc. The scaffoldings shall be erected under the Control and supervision of an experienced and competent person. For erection, good and standard quality of material only shall be used by the Contractor.

31.10 The Contractors shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Owner or other contractor under any circumstances, whatsoever, unless expressly permitted in writing by RSDCL to handle such fuses, wiring or electrical equipment.

31.11 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or RSDCL, he shall:

(a) Satisfy the Engineer that the appliance is in good working conditions.
(b) Inform the Engineer of the maximum current rating, voltage and phases of the appliances.
(c) Obtain permission of the Engineer detailing the sockets to which the appliances may be connected.

31.12 The Engineer will not grant permission to connect until he is satisfied that:

(a) The appliance is in good condition and is fitted with suitable plug.
(b) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.

31.13 No electric cable in use by the RSDCL will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it.

31.14 No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Engineer and a permit to work shall be issued by the Engineer before any repair work is carried out by the Contractor. While working on electric lines/equipment
whether live or dead, suitable type and sufficient quantity of tools will have to be provided by Contractor to electricians/ workmen/office.

31.15 The Contractors shall employ necessary number of qualified, full time electricians/ Electrical supervisors to maintain his temporary electrical installations.

31.16 The Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ at least one full time officer exclusively as safety officer to supervise safety aspects of the equipment and workmen, who will coordinate with the Project Safety officer. In case of work being carried out through subcontractors, the sub-contractor’s workmen/employees will also be considered as the Contractor’s employees/workmen for the above purpose.

The name and address of such Safety Officer of Contractor will be promptly informed in writing to Engineer with a copy to Safety Officer-Incharge before he starts work or immediately after any change of the incumbents is made during currency of the Contract.

31.17 In case, any accident occurs during the construction/erection or other associated activities undertaken by the Contractor thereby causing any minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer in prescribed form and also to all the authorities envisaged under the applicable laws.

31.18 The Engineer of RSDCL shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and/or property, and/or equipments. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove short-comings promptly. The Contractor after stopping the specific work can, if felt necessary, appeal against the order of stoppage of work to the Engineer within 3 days of such stoppage or work and decision of the Engineer in this respect shall be conclusive and binding on the Contractor.

31.19 The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided in para 31.18 above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of recoveries/penalties.

31.20 It is mandatory for the Contractor to observe during the execution of the works, requirements of safety rules which would generally include but not be limited to following:

SAFETY RULES:

(a) Each employee shall be provided with initial indoctrination regarding safety by the Contractor, so as to enable him to conduct his work in a safe manner.
(b) No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazards incident thereto, both to himself and his fellow employees.
(c) Under no circumstances shall an employee hurry or take unnecessary chance when working under hazardous conditions.
(d) Employees must not leave naked fires unattended. Smoking shall not be permitted around fire prone areas and adequate firefighting equipments be provided at Crucial locations.
(e) Employees under the influence of any intoxicating beverage, even to the slightest degree shall not be permitted to remain at work.
(f) There shall be a suitable arrangement at every work site for rendering prompt and sufficient first aid to the injured.
(g) The staircases and passage ways shall be adequately lighted.
(h) The employees when working around moving machinery must not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment.
(i) The employees must use the standard protection equipment intended for each job. Each piece of equipment shall be inspected before and after it is used.

(j) Requirements of ventilation in underwater working to licensed and experienced divers use of gum boots for working in slushy or in inundated conditions are essential requirements to be fulfilled.

(k) In cases of rock excavation blasting shall invariably be done through licensed blasters and other precautions during blasting and storage/transport of charge material shall be observed strictly.

31.21 The Contractor shall follow and comply with all RSDCL safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any discrepancy between statutory requirement and RSDCL safety Rules referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent.

31.22 If the Contractor fails in providing safe working environment as per RSDCL/Govt. Safety Rules or continues the work even after being instructed to stop work by the RSDCL as provided in para '31.18' above, the Contractor shall promptly pay to RSDCL, on demand by RSDCL compensation at the rate of Rs. 5000/- per day or part thereof till the instructions are complied with and so certified by the Engineer of RSDCL. However, in case of accident taking place causing injury to any individual, the provisions contained in para 31.23 shall also apply in addition to compensation mentioned in this para.

31.23 If the Contractor does not take all safety precautions and/or fails to comply with the Safety rules as per Govt. provisions or under the applicable law for the safety of the equipment & plant and for the safety of personnel and the Contractor does not prevent hazardous conditions which cause injury to his own employees or employees of other contractors, or RSDCL employees or any other person who are at Site or adjacent thereto, the Contractors shall be responsible for payment of compensation to RSDCL as per workman compensation Act & to others who-so-ever are affected as per prevailing laws in force.

The above are applicable for death/injury to any person whosoever.

Permanent disablement shall have same meaning as indicated in Workmen's Compensation Act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the workmen's Compensation Act & Rules framed there under or any other applicable laws as applicable from time to time.

In case the RSDCL is made to pay such compensation then the Contractor shall reimburse to the RSDCL such amount in addition to the compensation indicated above.

31.24 If the contractor observes all the Safety Rules and Codes, Statutory Laws and Rules during the currency of Contract awarded by RSDCL and no accident occurs then RSDCL may consider to issue a certificate regarding "ACCIDENT FREE WORKING".

32.0 CODE REQUIREMENTS

The erection requirements and procedure to be followed during the installation of equipments shall be in accordance with the relevant Codes and accepted good engineering practice, the Engineer's Drawings and other applicable Indian recognized codes and laws and regulations of the Govt. of India.

33.0 FOUNDATION DRESSING & GROUTING

33.1 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the requirement level, prior to placement of equipments/equipment bases on the foundations.

33.2 All the equipment bases and structural steel base plates shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.
33.3 The concrete foundations surfaces shall be properly prepared by chipping, grinding as required to bring the type of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength. All laitance and surface film shall be removed and cleaned.

34.0 CHECKING OF EQUIPMENT AFTER GROUTING

After the grout is set and cured, the contractor shall check & verify the alignment and level of the equipments & the slopes of all pedestals as applicable and the like items to ensure that no displacement has taken place during grouting. The values recorded prior to grouting shall be used during such post grouting checkup and verifications. Such pre and post grout records of alignment details shall be maintained by the contractor in a manner acceptable to the Engineer.

35.0 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid & terminated by the owner, the contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

36.0 COMMISSIONING SPARES

36.1 It will be the responsibility of the Contractor to provide all commissioning spares required for initial operation till the equipment is declared by RSDCL as ready for commissioning. The contractor shall furnish a list of all commissioning spares within 60 days from the date of letter of Award and such list shall be reviewed by the RSDCL and mutually agreed to. However, such review & agreement will not absolve the contractor of his responsibilities to supply all commissioning spares so that initial operation does not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the contract at no extra cost to the RSDCL.

36.2 These spares shall be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of commissioning of the respective equipment & utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of performance and guarantee tests shall be the property of the contractor and he will be allowed to take these parts back at his own cost with the permission of RSDCL.

37.0 CABLELING

37.1 All cables shall be supported on cable racks or cable trays run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surface with right angle turn made at specified radii. Cables shall be clamped at a minimum interval of 1000 mm or otherwise as directed by the Engineer.

37.2 Each cable, whether power or control, shall be provided with an aluminium tag of an approved type, bearing cable reference number indicated in the cable schedule (prepared by the contractor and approved by RSDCL) at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

37.3 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer’s recommendations. Wherever cables cross roads and water, oil, sewage or Gas lines, special care should be taken for the protection of the cables in designing the cable canals.
37.4 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

37.5 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to RSDCL's approval, Multi-core control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilizing plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be secure and even.

37.6 The connectors for control cables shall be covered with an insulating sleeve crimped with the terminal lug so as to prevent accidental contact with ground or adjacent terminals and shall preferably be terminated in elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

38.0 CONTRACTOR'S REPRESENTATIVE AND WORKMAN:

If supervision of erection or complete erection be included then the Contractor shall employ at least one competent representative, whose name or names shall have previously been communicated in writing to RSDCL by the Contractor to superintend the erection of the plant and carrying out of the works. The said representative or if more than one shall be employed then one of such representative shall be present on the site during working hours and any written orders or instructions which the Engineer of RSDCL or his duly authorised representative (whose name shall have been previously communicated in writing to the Contractor) may give to the said representative of the Contractor shall be deemed to have been given to the Contractor and the Contractor shall remove the person so objected to, upon receipt a notice from the RSDCL in writing requiring him to do so and shall provide in his place a competent representative at the Contractor's expenses.

39.0 LABOUR AND EMPLOYEES:

39.1 ENGAGEMENT OF LABOUR:

The Contractor shall make his own arrangements for the engagement of all labour, local or otherwise and save in so far as the contract otherwise provides, for the transport, insofar housing, feeding and payment thereof.

39.2 SUPPLY OF WATER:

The Contractor shall, so far as is reasonably practicable having regard to local conditions, provide on the site to the satisfaction of the Engineer's representative, adequate supply of drinking and other water for the use of the Contractor’s staff and work people.

39.3 ALCOHOLIC LIQUOR OR DRUGS:

The Contractor shall not, otherwise than in accordance with the statutes, ordinances, and Govt. regulations or orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs or permit or suffer any such importation, sale, gift, barter, consumption or disposal by his sub-contractors, agents or employees and labour.

39.4 ARMS AND AMMUNITION:

The Contractor shall not give, barter or otherwise dispose of to any person or persons including his sub-contractors, agents or employees and labour any arms or ammunition of any kind or permit or suffer the same as aforesaid in clause No. 29.3.
39.5 FESTIVALS AND RELIGIOUS CUSTOMS:

The Contractor shall in all dealings with labour in his employment have due regard to all recognized festivals, day of rest and religious or other local customs.

39.6 EPIDEMICS:

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Govt. or the local medical or sanitary authorities for the purpose of dealing with and overcoming the same.

39.7 DISORDERLY CONDUCT ETC:

The Contractor shall at all time take reasonable precautions to prevent any unlawful, rich or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in the neighborhood of the works.

39.8 OBSERVANCE BY SUB-CONTRACTORS:

The Contractor shall be responsible for observance by his Sub-Contractors of the foregoing provisions.

39.9 RETURNS OF LABOUR ETC:

The Contractor shall, if required by the Engineer, deliver to the RSDCL's representative or at his office, a return in detail in such form and at such intervals as the RSDCL may prescribe showing the supervisory staff and the numbers of the several classes of labour from time to time employed by the Contractor on the site and such information in respect of constructional plant as the RSDCL Engineer may require.

40.0. EMPLOYEES:

(a) The Contractor shall provide and employ on the site in connection with the execution and maintenance of works:

(i) Only such technical assistants as are skilled and experienced in their respective callings and such sub agents, foremen and leading hands as are competent to give proper supervision to the work they are required to supervise.

(ii) Such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution and maintenance of the works.

(b) The Engineer/Engineer’s representative shall be at liberty to object to and require the Contractor to remove forthwith from the works any person employed by the Contractor in or about the execution or maintenance of the works who in their opinion misconducts himself, or is incompetent or negligent in the proper maintenance of his duties or whose employment is otherwise considered undesirable and such person shall not be again employed upon the works without the written permission of the Engineer. Any person so removed from the works shall be replaced as soon as possible by a competent substitute approved by the Engineer.

(c) EMPLOYEES PROVIDENT FUNDS:

The Contractor shall have to submit a certificate every month that he is an establishment covered under the Employees Provident Fund and Miscellaneous provisions Act, 1952 and is having a separate code number with the provident fund commissioner and also that the provident fund contribution in respect of all the employees employed by him along with employer’s share of contribution etc. is being deposited with the provident fund authorities and shall also submit certified photo copies of the challans of deposits. In absence of above, the Contractor shall be liable to deposit employees, as well as,
Employer’s contribution and other charges in respect of all the employees engaged by him for the said work with RSDCL along with details of the employees, their wages and the amount of contribution as per RSDCL CPF Rules every month. In case of failure, RSDCL shall be entitled to deduct 16% of the amount from his bills.

41.0 GENERAL RESPONSIBILITIES OF THE CONTRACTOR:

41.1 WORKS EXECUTION:

The Contractor shall, subject to the provision of the contract and with due care and diligence execute and maintain the works and provide all labour, including the supervision thereof, materials, constructional plant and all other things, whether of a temporary or permanent nature, required in and for such execution and maintenance, so far as the necessity for providing the same in specified in or is reasonably to be inferred from the contract.

41.2 WORKS SAFETY:

The Contractor shall take full responsibility for the adequacy, and safety of all site operations and method of construction, provided that the Contractor shall not be responsible, except as may be expressly provided in the contract for the design or specification of the permanent works.

41.3 SUPERINTENDENCE BY THE CONTRACTOR:

The Contractor shall give or provide all necessary Superintendence during the execution of the works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor’s obligations under the contract.

41.4 SETTING OUT OF WORKS:

The Contractor shall be responsible for the true and proper setting out of the works in relation to original points, lines and levels of reference given by the Engineer in writing and for the correctness, subject as mentioned above of the position, levels, dimensions, and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection therewith. If, at any time during the progress of the works, any error shall appear or arise in the position levels, dimensions, or alignment of any part of the works, the Contractor on being required so to do by the Engineer, shall at his own cost, rectify such error to the satisfaction of the Engineer unless such error is based on incorrect data supplied in writing by the Engineer, in which case the expense of rectifying the same shall be borne by the owner. The checking or setting out of or any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench-marks, sight rails, pegs and such other thing used in the setting out of the works.

41.5 CARE OF THE WORKS:

From the date of commencement of the works until the date stated in the certificate of completion for the whole of the works the Contractor shall take full responsibility for the care thereof. Provided that if the Engineer shall issue a certificate of completion in respect of any part of the permanent works, the Contractor shall cease to be liable for care of that part of the permanent works from the date stated in the certificate of completion in respect of that part and the responsibility for the care of that part shall pass on to the owner. In case of any damage, loss or injury shall happen to the works, or to any part thereof, from any cause whatsoever, the Contractor shall at his own cost, repair and make good the same so that the completion of the permanent works shall be in good order and in condition and in conformity in every respect with the requirements of the contract.

41.6 WATCHING AND LIGHTING:

The Contractor shall in connection with the works provide and maintain at his own cost all lights, guards, fencing and watching when and where necessary or required by the
Engineer/Engineer’s representative or by any duly constituted authority, for the protection of the works or for the safety and convenience of the public and others.

41.7 CONTRACTOR TO KEEP SITE CLEAR:
During the progress of the works, the Contractor shall keep the site free from all unnecessary obstruction and shall dispose off any constructional plant surplus materials, and clear away and remove from the site any wreckage, rubbish or temporary works no longer required.

41.8 CLEARANCE OF SITE ON COMPLETION:
On the completion of the works the Contractor shall clear away and remove from the site all constructional plant, surplus materials, rubbish and temporary works of every kind and leave the whole of the site and works clean and in a workman like condition to the satisfaction of the Engineer.

41.9 WORK TO BE DONE TO THE SATISFACTION OF RSDCL:
Save in-so-far as it is legally or physically impossible, the Contractor shall execute and maintain the works strictly in accordance with the contract to the satisfaction of the RSDCL Engineer and shall comply with and adhere strictly to their instructions and directions on any matter whether mentioned in the contract or not.

41.10 WAY LEAVES:
The Contractor shall bear all costs and charges for special or temporary way leaves required by him in connection with access to work sites.

41.11 PLANT, TEMPORARY WORKS AND MATERIALS:
All constructional plant, temporary works and materials provided by the Contractor shall, when brought to the site, be deemed to be exclusively intended for the execution of the works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the site to another.

41.12 REMOVAL OF PLANT ETC:
Upon completion of the works, the Contractor shall remove from the site all the said constructional plant, temporary works remaining thereon and any unused material provided for by the Contractor.

41.13 OWNER NOT LIABLE FOR DAMAGE TO PLANT ETC:
The Contractor shall note that the RSDCL shall not at any time be liable for the loss of or damage to any of the aforesaid constructional plant, temporary works or materials.

* * *
PART-V

SCHEDULES AND ANNEXURES
SCHEDULE-I(B)
(Must be filled in by the bidder and to be uploaded with Techno-commercial Bid, cover-2)

To,

The Director (Technical),
Rajasthan Solarpark Development Company Ltd.,
JAIPUR-302001.

Dear Sir,

With reference to your invitation to the tender against specification No.RSDCL/ D(T)/SP/Nokh/PPS/TK/TN-03(2019-20),we agree to construct following 220kV Park Pooling Sub-stations on turnkey basis for which required Bid Security has been deposited:-

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF SUBSTATION (a)</th>
<th>NAME OF DIRECT SUPPLY ITEMS (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Park Pooling Sub-station-1 to 4</td>
<td></td>
</tr>
</tbody>
</table>

1. The offer is valid for a period of 180 days after the date of opening of Techno-commercial Bid.

2. The prices shall be “Firm” and no variation shall be allowed in this tender enquiry.

3. It is noted that the quantities as mentioned in the specification are approximate and we agree to supply any quantity as per your requirement.

4. The completion period of Park Pooling Stations shall strictly be in accordance with Clause No. 10 of SCC-Part III, Volume-I of this specification. In case, we fail to complete the Park Pooling Stations as indicated in the clause No. 10 of SCC-Part III, Volume-I, we shall pay penalty as per Clause No. 14 of GCC Part-II, Volume-I of this specification.

5. The material shall conform to your specification No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20) and as per relevant ISS in all respect.

6. We confirm that we agree to all the terms and conditions as well as the technical stipulations of your specification No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20) and there are no deviations other than as specified in the Schedule-V.

Your's faithfully,

(Signature)
Name & Designation with Seal of the firm
To,
The Director (Technical),
Rajasthan Solarpark Development Company Ltd.
Jaipur-302001.

Sub:-Tender for construction of 220/33 kV Park Pooling Sub-station(s) on turnkey basis against Specification No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20).

Dear Sir,

1.0 We, the undersigned bidder have read and examined in detail, the specifications and documents under TN-03(2019-20) and hereby offer our bid for the construction/erection, testing, commissioning, civil works alongwith handholding of following 220 kV Park Pooling Sub-stations on "Turnkey Basis" against specification No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20):

(i) 220/33kV Pooling Station-1
(ii) 220/33kV Pooling Station-2
(iii) 220/33kV Pooling Station-3
(iv) 220/33kV Pooling Station-4

2.0 PRICE AND VALIDITY:

2.1 All the prices and price components stated in our proposal shall be ‘FIRM’ in all respect independent of any variation.

2.2 The prices, all terms and conditions in our offer are valid for a minimum period of 180 days from the specified date of Techno-commercial bid opening.

2.3 We do hereby confirm that our FORD bid price of all bought out items (either received at site directly from vendors or supplied through us) as quoted in relevant schedules includes all taxes, duties, octroi and other levies except GST and we shall have no extra claim in this regard. We also confirm that prices quoted for erection, testing, commissioning and for civil works & handholding of Park Pooling Stations include all applicable taxes, duties and other levies etc. except GST and we shall have no extra claim in this regard.

2.4 All taxes/ duties with cess, local taxes, octroi and other levies except GST in respect of transaction between you and us for all goods, dispatched from our manufacturing works, if any, shall be to our account and have been included in our bid price.

2.5 We hereby confirm that if any Income Tax, Surcharge on Income Tax or any other Corporate Tax is attracted under the law, we agree to pay the same.

3.0 BID PRICING:

We further declare that prices stated in our proposal are in accordance with all relevant commercial terms and conditions specified in volume-I of the specification and we have not taken any deviation to the conditions as indicated at Clause No.4 of accompanying Special Conditions of Contract.

4.0 CONSTRUCTION OF THE CONTRACT.

We declare that we are making the offer on the basis of a divisible supply cum erection, testing, commissioning, handholding cum execution of civil works of Pooling Sub-stations
contract on single source responsibility basis. The supply portion of the contract relate to supply of the equipments & materials and the erection portion will relate to transportation, insurance, storage, erection, testing and commissioning etc. of equipments and materials as defined in bid documents alongwith handholding. Civil works portion will relate to execution of civil works of Park Pooling Stations. We declare that the award of separate supply, erection, testing & commissioning and civil works contracts will not in any way dilute our responsibilities for successful operation of equipments as per specifications (Volume-I, II & III) and that all these contracts will have a cross fall breach clause viz that a breach on one contract will automatically be classified as breach for the other contract which will confer on the OWNER, the right to breach to other contract at our risk and cost.

5.0 SPECIAL TOOLS AND TACKLES.

We have also given a list of special tools and tackles in our bid required for completion of works and the prices of the same are included in our lumpsum quoted bid price. We further agree that any items of special tools and tackles though not included in the aforesaid list, but are required for effective erection, testing, commissioning and operation of 220/33 kV Park Pooling Stations upto handing over of same to RSDCL shall also be provided by us at no extra cost to you.

6.0 BID GUARANTEE (EMD)

We have enclosed a Demand Draft for a sum of Rs.____in favour of ManagingDirector, RSDCL Jaipur and a Bank Guarantee for a sum of Rs.____in favour of Managing Director, RSDCL Jaipur as a bid security in accordance with bid documents.

7.0 CONTRACT PERFORMANCE GUARANTEE

We further agree that if our proposal is accepted we shall provide an irrevocable Contract Performance Guarantee, of value equivalent to ten percent (10%) of the total Contract value valid upto the end of ninety (90) days after the end of the contract guaranty period in the form of ____________________________ (Please specify the form of Guarantee) in your favour and enter into a formal agreement with you within fifteen (15) days from the date of issue of order(s) of Contract.

8.0 CONTRACT SECURITY GUARANTEE:

We further agree that if our proposal is accepted we shall provide an irrevocable contract security guarantee, equivalent to 2% of the total contract value valid upto the end of 90 (ninety) days after commissioning and handing over of Pooling Stations to RSDCL in the form of ____________________________ (Please specify the form of guarantee) in your favour.

9.0 We, hereby declare that only the persons of firms interested in this proposal as principles are named herein and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the contract to be entered into, if we are awarded the Contract, and that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal and that this proposal is complete in all respect for and in good faith, without collusion of fraud.

Date this ________________day of ________________20 .

Thanking you, we remain.

Your's faithfully

Designation____________
(Seal)________________

Business Address:
Country of incorporation (State or Province to be indicated)
Name and address of Principal Officer
SCHEDULE-III

INFORMATION REQUIRED FROM FIRMS ALONGWITH THEIR TECHNO-COMMERCIAL BID
(COVER-2)

1. Lead Agency
   Name
   Address

2. Other Collaborator/Partner.
   Name
   Address

3. Details to be furnished:
   (i) Full Legal Name
   (ii) Full Address of
        (a) Registered Office:
        (b) Office where to correspondence to be made:
   (iii) Authorised Contact Person(s):
        (Power of Attorney to be enclosed)
   (iv) Mobile/Phone No.
   (v) Telex No.
   (vi) Telefax No./Email.
   (vii) Telegraphic Address:
   (viii) Nature of registration of agency.
          (Whether sole/Proprietor/Partnership/ Private Limited/Public Limited.)
   (ix) Memorandum of Association and Articles of Association of the Agency.

4. MODE OF PARTICIPATION.
   (i) As single bidder
   (ii) On Joint venture basis.

5. BASIS OF PARTICIPATION:
   The firm shall clearly indicate whether it:
   Desires to take up the entire work of construction of 220/33 kV Pooling Stations on Turnkey Basis and to be completed as per specification.

6. EXPERIENCE IN EXECUTION OF 220 KV AND ABOVE SUB-STATION WORK
   Agencies intending to participate for these works should furnish briefly their past experience in the enclosed track record proforma as schedule-IV for Substation.

7. (a) Indicate the responsibilities undertaken in executing 220Kv & above voltage class Substation.
   (i) Design and engineering
   (ii) Preparation of specification for procurement items.
   (iii) Procurement
(iv) Construction and erection.
(v) Testing and commissioning.
(vi) Performance guarantee(s)
(vii) Operation and maintenance.

8. What was the financing arrangement for above work? Whether the funding was done by the Agency or through a separate financial institution.

9. **FINANCIAL DETAILS.**
   Agencies are required to furnish details of financial structure of the company and provide Annual Financial Report, Balance sheet, Profit & Loss account of the company for the past 5 (five) years.
   b) Balance Sheet.
   c) Solvency Certificate.
   d) ITCC.

10. Agencies are required to indicate funding proposals for 220/33 kV Park Pooling Stations.
    (i) Equity proposed to be brought in:
        (a) by the single bidder/lead partner of Joint venture.
        (b) other collaborators/ Joint venture partners/ Financial Institution(s).
    (ii) Debt profile/source of debt.
        (a) Indian
        (b) Suppliers credit etc.

11. **ORGANISATIONAL STRUCTURE AND CAPABILITY.**
    Agencies should furnish the following information/document in respect of their organisation:
    (i) Corporate structure.
        Details of various divisions/departments including manpower available and responsibilities undertaken by such divisions/departments.
    (ii) List of **220KV or above** GSS constructed/owned and/or operated & maintained by the agency.
    (iii) Proposed organization structures for execution of work under consideration.
    (iv) Any other information which the Agency considers relevant.

NOTE: Please furnish documents in support of the above, wherever necessary.

PLACE:                        STATUS
NAME
ADDRESS OF FIRM
DATE:                        SEAL OF THE FIRM
### SCHEDULE-IV

**DETAILS OF PAST EXPERIENCE OF EXECUTED WORKS IN RESPECT OF 220KV OR ABOVE VOLTAGE CLASS GRID SUB STATION ON TURNKEY BASIS DURING LAST 7 YEARS FROM THE DATE OF BID OPENING**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Legal Name under which Sub-Station constructed</th>
<th>Details of Sub-Station executed</th>
<th>Voltage Class &amp; Sub-Station Capacity</th>
<th>Year from which Sub-Station working satisfactorily</th>
<th>Contractual Completion Period</th>
<th>Actual Completion Period</th>
<th>Single Agency or Collaboration/ Joint Venture/ Consortium</th>
<th>Name of Collaborator Member or Consultant</th>
<th>Basis on which Scheme executed</th>
<th>Cost of Sub-Station Constructed</th>
<th>Details of the Scope of Work executed</th>
<th>Remarks</th>
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PLACE:  

DATE:  

* BIDDER SHALL FURNISH THE SATISFACTORY OPERATION CERTIFICATE OF EXECUTED GSS FROM THE CLIENT FOR A PERIOD OF ATLEAST ONE YEAR.
SCHEDULE-V

SPECIFICATION No. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20)

DEVIAATION FROM SPECIFICATION

(TO BE FURNISHED SEPARATELY FOR COMMERCIAL/TECHNICAL DEVIATIONS)

ALL THE DEVIATIONS FROM THIS SPECIFICATION NO. RSDCL/D(T)/SP/Nokh/PPS/TK/TN-03(2019-20) IF ANY, SHALL BE SET OUT BY THE TENDER CLAUSE IN THIS SCHEDULE ONLY. UNLESS SPECIFICALLY MENTIONED IN THIS SCHEDULE, THE TENDER SHALL BE DEEMED TO CONFIRM TO THE SPECIFICATION. DEVIATIONS MENTIONED ELSEWHERE IN THE BID SHALL NOT BE CONSIDERED.

<table>
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<tr>
<th>S.NO.</th>
<th>CLAUSE NO.</th>
<th>EXISTING TEXT</th>
<th>PROPOSED DEVIATION</th>
<th>JUSTIFICATION/REASONS</th>
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NOTE: DEVIATIONS MENTIONED ELSEWHERE IN THE BID SHALL NOT BE CONSIDERED BY THE OWNER.

PLACE: 
SIGNATURE OF BIDDERS
STATUS NAME
DATE: 
SEAL OF THE FIRM
SECURITY BANK GUARANTEE
(On non-judicial stamp paper of requisite value)

Bank Guarantee in lieu of Security deposit on non-judicial stamp paper of Rajasthan Govt. worth Rs-----(stamp paper value required as per GoR norms).

The Managing Director,
Rajasthan Solarpark Development Company Ltd.
Jaipur-302001.

In consideration of the Managing Director, Rajasthan Solarpark Development Company Limited, Jaipur (hereinafter called the Purchaser/Owner) having agreed that in respect of order No.______ dated ______ (hereinafter referred to as contract) placed with M/s. ___________________________________________________________________________ having their registered office at ____________________________________ (herein after called the contractor) the contractor needs not furnish the security deposit in cash and/or Bank Draft. We the _______________ (hereinafter called the Bank) undertake to pay the purchaser on demand the sum or sums of money pay able as security deposit by the contractor in respect of Order No. ___________ dated __________ placed by the RSDCL with the contractor subject to the following terms& conditions.

1) Payment pursuant in this undertaking will be demanded by the purchaser from the Bank and will be met by the Bank without question in the case in which the Contractor, on receipt of the order and/or after the acceptance of this tender has been communicated to him by the purchaser, make default in entering into an agreement or having entered into such Agreement or otherwise the contractor makes default in carrying out the contract thereof. As to whether the occasion or ground is arisen for such demand the decision of the Managing Director, RSDCL shall be final.

2) The liability of the Bank shall not at any time exceed to Rs. _______ (Rupees ____________________________________) 

3) The undertaking will be determined on________ but will not withstanding such determination, continue to be in force till the expiry of 3 months from the date of completion of Pooling Stations complete in all respect as per specification against the aforesaid order.

4) No variation in the terms of tender, acceptance or agreement as between the contractor and the purchaser made without the purchaser’s consent shall discharge this undertaking.

5) No indulgence or grant of time by the purchaser to the contractor without the acknowledgement of the Bank will discharge the liabilities of the Bank under this guarantee.

6) The guarantee herein contained shall not be affected by any change in the constitution of the contractor.

7) Notwithstanding anything contained herein before the Bank’s liability under this guarantee is restricted to Rs.________ (Rupees_________________) and the guarantee shall remain in force upto __________ unless demand or claim in writing is presented on the Bank within 3 months from the date, the Bank shall be released and discharged from all liabilities there under.

8) All disputes arising under the said guarantee between the Bank and the COMPANY or between the contractor and the Company pertaining to the guarantee shall be subject to the jurisdiction of Courts only at Jaipur in Rajasthan.
(9) The Bank further undertakes not to revoke this guarantee during its currency except with the previous consent of the Managing Director, RSDCL.

IN WITNESS WHEREOF the Bank has executed these presents the day_______and year ________________.

Your’s faithfully,

Bankers (EXECUTENT)

Signed by the above named Bank in presence of :-
(Signature with full Name and Address)

Witness :

1.___________________

2.___________________

Attested by Notary Public, First Class Magistrate or directly confirmed by the executing bank.

Note:- In case the bid is submitted by a Joint Venture, the Bid Bank guarantee shall be in the name of Lead partner or in the name of joint venture partners submitting the Bid covering all the partners of the joint venture.
ANNEXURE-II

Performance Bank Guarantee Form
(On Non-judicial Stamp Paper of requisite value)

To,

The Managing Director,
Rajasthan Solarpark Development Company Ltd.,
Jaipur-302001.

Dear Sir,

THIS DEED OF GUARANTEE is made this day ________ of __________________ of the year ________ between the Managing Director, Rajasthan Solarpark Development Company Limited (which expression shall unless excluded by or repugnant to the context includes his successors and assignees) of the one part and the _________________________ hereinafter called “The Bank” (which expression shall unless excluded by or repugnant to the context includes its successors and assignees) of the other part.

WHEREAS MESSERS ________________________ (hereinafter called contractor) agreed for supply of material and equipments and erection, testing and successful commissioning & execution of civil works & handholding of 220kV PPS ________ ________ (Name of Sub-station, works) to the Managing Director, Solarpark Development Company Ltd, JAIPUR.

against Order No. _________________ dated _____ (hereinafter referred to as the contract).

AND WHEREAS as per the terms of the contract, it was provided that the contractors should furnish a Bank Guarantee equivalent to ______% ______of the total contract value (supply of material/equipments, ETC charges and cost of civil works & handholding of Pooling Stations) by way of security for supplying free of cost any material/equipment, carrying out of erection/commissioning and civil works that may be required due to defect arising from faulty materials, design and workmanship, so as to make it meet the guarantee and requirements of the contract.

AND WHEREAS at the request of the contractors, the Bank has agreed to execute these present

NOW THIS INDENTURE WITNESS AND IT IS HEREBY AGREED AND Rajasthan Solarpark Development Company Limited DECLARED by the and between the parties hereto as follows:

1. The Bank hereby guarantees to the, the fulfillment by the contractors of the various obligations imposed on them under the aforesaid contract including the obligations of the contractors to supply and install materials/equipments and test/commission the equipments of the good quality and workmanship and the bank further guarantees to the RSDCL that the contractors shall substitute and supply and install, commission free of cost any material, equipment that may be required due to defects arising from faulty material, design and workmanship and the Bank undertakes to indemnity and keep the Managing Director, Rajasthan Solarpark Development Company Ltd JAIPUR indemnified to the extent of Rs.______ (in words Rupees ________) against any loss or damage may be caused to or suffered by the Rajasthan Solarpark Development Company Ltd by reason of any failure by the contractors to supply and install materials/equipments of good quality, design and workmanship as aforesaid and further undertake to pay to the Managing Director, RSDCL on demand a sum not exceeding Rs.______ (Rupees ____________) in the event of the contractor failing or neglecting to perform and discharge the aforesaid duties and obligations on their part to be observed and performed under the said contract indemnified to the extent of Rs._______(in words Rupees__________ )
against any loss or damage may be caused to or suffered by the Rajasthan Solarpark Development Company Ltd. by reason of any failure by the contractors to supply and install materials/ equipments of good quality, design and workmanship as aforesaid and further undertake to pay to the Managing Director, RSDCL on demand a sum not exceeding Rs.________ (Rupees ____________) in the event of the contractor failing or neglecting to perform and discharge the aforesaid duties and obligations on their part to be observed and performed under the said contract indemnified to the extent of Rs.________(in words Rupees ____________) against any loss or damage may be caused to or suffered by RSDCL by reason of any failure by the contractors to supply and install materials/ equipments of good quality, design and workmanship as aforesaid and further undertake to pay to the Managing Director, RSDCL on demand a sum not exceeding Rs.________ (Rupees ____________) in the event of the contractor failing or neglecting to perform and discharge the aforesaid duties and obligations on their part to be observed and performed under the said contract.

The decision of the Managing Director, RSDCL as to whether the contractor have failed or neglected to perform or discharge their duties and obligations as aforesaid and as to the amount payable to the Managing Director, RSDCL by the Bank herein shall be final and binding on the Bank.

2. The guarantee herein contained shall remain in full force and effect during the performance period that would be taken for the performance of the said contract and it shall continue to be enforceable till all the obligations to the RSDCL under or by force of the contract have been fully and properly discharged by the said contractor(s), subject however, to the conditions that the RSDCL will have not right under this guarantee after 12 months from the date of handing over of Pooling Station(s) complete in all respect after its successful commissioning provided further that if any, claim arises by virtue of this guarantee before the aforesaid date or extended guarantee period date if any, the same shall be enforceable against this bank notwithstanding the fact that the same is enforced after the aforesaid date.

The general guarantee period for all equipments, items, works etc. (except mentioned in the Technical specification of individual items) against this contract TN-03(2019-20) shall be 12 months from completion of Pooling Station(s) & its handing over to RSDCL and up to extended guarantee period if any as per provisions of contract.

3. The guarantee herein contained shall not be affected by any change in the constitution of the contractor(s) or Bank.

4. The Managing Director, RSDCL shall have the fullest liberty without affecting the guarantee to postpone for any time and from time to time any of the powers exercisable by the COMPANY against contractor(s) and either to enforce or forebear from enforcing any of terms and conditions of the said contract and the Bank shall not be released from its liability under this guarantee and exercise of the RSDCL of the liberty with reference to the matter raised or by the reasons time being given to the contractor(s) or any other forbearance act or omission on the part of the RSDCL to the contractors or by any other matter or thing whatsoever which under the law relating to the sureties shall but for this provision have the effect of so releasing the bank from such liability.

5. Managing Director, RSDCL includes any other officer nominated by Managing Director, RSDCL.

6. The Bank further undertakes not to revoke the guarantee during its currency except with the previous consent of the Managing Director, RSDCL in writing.
7. All disputes arising under the said guarantee, between the Bank and the Company or between the contractor and the Company pertaining to the guarantee, shall be subject to the jurisdiction of Courts, only at Jaipur in Rajasthan alone.

8. Notwithstanding anything contained herein before, the Bank’s liability under this guarantee is restricted to Rs._________(Rupees ___________) and the guarantee shall remain in force upto __________________________ unless demand or claim in writing is presented on the Bank within six months from that date, the Bank shall be released and discharged from all liabilities thereunder. However, the validity of the bank guarantee shall be extended as and when required by the Company.

9. IN WITNESS WHEREOF THE BANK HAS executed these presents the days and year written above.

Your’s faithfully,

Bankers (EXECUTENT)

Signed by the above named Bank in presence of :-
(Signature with full Name and Address)

Witness :
1. ________________
2. ________________

Attested by Notary Public, First Class Magistrate or directly confirmed by the executing bank.

Note:- In case the bid is submitted by a Joint Venture, the Bid Bank guarantee shall be in the name of Lead partner or in the name of joint venture partners submitting the Bid covering all the partners of the joint venture.
ADVANCE BANK GUARANTEE

(Advance Bank Guarantee on non-judicial stamp paper of Rajasthan Govt. of requisite value)

The Managing Director,                        GUARANTEE NO.____
Rajasthan Solarpark Development Company Ltd.,   DATE _____________
Jaipur (RAJ.)                                 AMOUNT ____________

DATE OF VALIDITY___________
DATE OF VALIDITY WITH GRACE PERIOD__________

THIS DEED OF GUARANTEE is made this day _____________of ____________ of the year _________
between the Managing Director, Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ.)
(which expression shall unless excluded by or repugnant to the context includes his successors,
assigns and his authorized representatives, hereinafter called “The Purchaser”) of the one part
and the________________________________, having its Head office at ________________________________
hereinafter called “The Bank” (which expression shall unless excluded by or repugnant to the
context includes its successors and assigns) of the other part.

WHEREAS MESSERS________________________________(hereinafter called “The Contractor”), having
their/its Registered/Head office at ____________________, agreed to supply the material to the
Managing Director, Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ.) against
Purchase order No._______ dated______________(hereinafter referred to as the contract).

AND WHEREAS  in terms of  the  Purchase Order,  the purchaser  has  agreed to pay to the
contractor an amount  of Rs.___________________ (Rupees_______ _____________) as advance against
submission, by  the said contractor, of a Bank Guarantee for a like sum.

AND WHEREAS the said purchaser has agreed to accept a Bank Guarantee from
_____________________, the Bankers of the said contractor.

AND WHEREAS at the request of the contractor the Bank has agreed to execute these presents.

NOW THIS INDENTURE WITNESS AND IT IS HEREBY AGREED AND DECLARED  by the and
between the parties hereto as follows:

1. We, _________________ hereby irrevocably guarantee  the due fulfillment by the said contractor
   of the said purchase/work order regarding supply of materials of the agreed manufacturers
   make(s) and we also hereby guarantee payment  to  the said purchaser upto and not exceeding
   altogether a sum of Rs.___________________ (Rupees_______ _____________), if the delivery of the
   material/equipments and completion of Pooling Stations is delayed from the date of
   contractual delivery/completion period to the date of actual delivery /completion and / or the
   amount if any payable by the contractor to the said purchaser on account of any breach on the
   part of said contractor in the performance of the said purchase order regarding supply and
   erection of material for ___________________

2. The decision of the Managing Director, Rajasthan Solarpark Development Company Ltd.
   JAIPUR (RAJ.) shall be final whether breach has been committed on the right to demand the
   amount of guarantee from us, which has accrued to the purchaser.

3. This guarantee shall not ceases or determine, if the purchaser grants time or indulgence or
   vary the terms of the contract with the contractor or without our consent or knowledge.

4. The guarantee herein contained shall not be affected by any change in the constitution of the
   contractor.

5. We, _________________ further undertake not to revoke this guarantee during its currency
   except with the previous consent of the Managing Director, Rajasthan Solarpark Development
   Company Ltd. Jaipur (Raj.)
6. All disputes arising under the said guarantee between the Bank and the Company or between the contractor and the Company pertaining to this guarantee shall be subject to the jurisdiction of Courts in Jaipur, Rajasthan alone.

7. This guarantee shall become operative on the day on which the said advance payment of Rs. _______________ is received by the contractor.

8. NOT WITHSTANDING anything contained herein before, our liability under this guarantee is restricted to Rs. _______________ (Rupees_________________), if the delivery of material and completion of Pooling Stations is delayed from the date of contractual delivery/completion period to the date of actual delivery/completion.

9. Our guarantee shall remain in force until ____ or 90 days from the date of actual taking over of the Pooling Stations whichever is later, but not later than _____, unless a demand or claim in writing is presented to us under the guarantee within six months from that date i.e. on or before ______ all the rights of the owner under the said guarantee shall be forfeited and we shall be released and discharged from all liabilities there-under.

Dated this _________________day __________ of the year _____

Your’s faithfully,

Bankers(EXECUTENT)

Signed by the above named Bank in presence of :-
(Signature with full Name and Address)

Witness :
1.___________________
2.___________________

Attested by Notary Public, First Class Magistrate or directly confirmed by the executing bank.

**Note:** In case the bid is submitted by a Joint Venture, the Bid Bank guarantee shall be in the name of Lead partner or in the name of joint venture partners submitting the Bid covering all the partners of the joint venture.
ANNEXURE-IV

PROFORMA OF APPLICATION FOR PAYMENT

Project : 

Equipment package : Date : 

Name of Contractor : Contract No. : 

Contract Value : Contract Name : 

Unit reference : Application Serial number : 

To 

.........................................
Rajasthan Solarpark Development Company Ltd. Jaipur (Raj.)

Dear Sir,

APPLICATION FOR PAYMENT

1. Pursuant to the above referred Contract Dated ...... the undersigned hereby applies for payment of the sum of ..........

2. The above amount is on account of :(check whichever applicable).
   (i) Initial advance (Schedule**)
   (ii) Progressive payment against despatch of equipment (Schedule **) 
   (iii) Progressive payment against Erection (Schedule**)
   (iv) Inland transportation (Schedule**)
   (v) Inland insurance
   (vi) Extra work not specified in contract
       (Ref. Contract change order No..................)
   (vii) Other (specify)
   (viii) Final payment (Schedule**)

as detailed in the attached schedule (s) which form an integral part of this application.

3. The payment claimed is as per item(s) No.(s)...... of the payment schedule annexed to the above mentioned Contract.

4. The application consists of this page, a summary of claim statement (Schedule**), and the following signed schedule
   1. ...................................................
   2. ...................................................
   3. ...................................................

The following documents are also enclosed
** Application for payment will be made to Director (Fin.), RSDCL, Jaipur with copy to the 'Engineer' as to be designated for this purpose at the time of award of the contract.

** Proforma for the Schedules will be mutually discussed and agreed to during the finalisation of the Contract Agreement.
This Indenture made at ______ on ______ this _____ day of the Month of ________________ of the year____________ between the Managing Director, Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ.) Limited (hereinafter referred to as the Purchaser which expression unless the context does not permit includes successors and assigns) of the one part and

(l) To be used in case of Limited Companies

Messers____________________________            a private/Public Limited Company incorporated_____________________ under the _______________________ companies act and having its Registered office at _____________________ (hereinafter referred to as Contractor which expression unless the context does not permit includes their successors and assigns).

(2) To be used in case of Partnership concerns

Messers ________________________________ a Partnership Firm consisting of the following Partners namely:

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<tr>
<th>(Name)</th>
<th>(Age)</th>
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(hereinafter referred to as Contractors which expression unless the context does not permit includes their respective heirs, executors, administrators, legal representatives, permitted assigns) of the second part, witness the as follows:-

(1) The contractor, does by these presents agree to supply to the Purchaser and the Purchaser does agree to purchase from the Contractor the material specified in the Purchaser order No. _______ dated ______ and amendment letter No.______ dated ______ appended and on the terms & conditions constrained in the said order and amendment letter. The General terms of the contract appended hereto are considered a part of this agreement.

(2) The Contractor has deposited Rs.______ (In words Rs.__________ )

(a) In cash, or

(b) by furnishing a Demand Draft No.______ dated ______ drawn in favour of ________ or

(c) by furnishing a Bank Guarantee equivalent to ____% of the Contract value, towards security deposit with the Purchaser for the performance of this agreement by the Contractor. The security deposit Receipt duly endorsed in favour of the Purchaser should be lodged to his safe custody.

(d) The contractor has not deposited any amount either in Cash or by furnishing Demand Draft /Bank Guarantee towards Security deposit but has agreed to accept ______% payment of each consignment as per stipulation (specified in clause relating to “Terms of Payment” of the Purchase Order).
(e) The contractor has agreed to deduct the amount Rs. _____ equivalent to______% of the contract value from their first supply bill(s) towards Security deposit as per stipulations of the Purchase Order.

(3) The Specifications of the materials to be supplied under this agreement shall be as set forth in the Schedule referred to above.

(4) (a) The Contractor is to deliver the material:-

(i) Ex-work ________

(ii) To F.O.R. Destination(s) anywhere in Rajasthan by Goods Train.

(iii) Free delivery at Contrator’s Stores/ Sites by Road Transport duly packed in good condition conforming to specification.

(b) Sales tax, duties and charges etc. which may be payable as per clause No. _________ of P.O. would be the contractor’s liability and if incurred would be to his account.

(c) If so required by the Purchaser, the contractor will book the consignments by Rail/ Road to any destination stipulated by the Purchaser.

(d) In case the consignments to be insured to cover risks in transit, such insurance charges, if payable would be to the contractor’s account.

(e) The Purchaser shall reimburse to the contractor all such expenditure, if any, that may be incurred by the contractor in this behalf under sub clause (b),(c) and (d) of this clause, if applicable as per provisions of contract by payment from time to time on receipt of the bills from the contractor supported by receipt or acknowledgement granted by Purchaser for supplies received.

(5) In case of dispute as to whether any materials supplied are or are not in accordance with specifications set-forth in the schedule, the decision of the Director(tech), RSDCL shall be final and binding on both the parties.

(6) The delivery shall be effected and completed as per clause No. ________ of the P.O. from the date of the Purchase Order and amendment letter No. ________ dt. ________. The first installment of supplies will begin as per clause No. ________ of the P.O. and amendment letter No. ________ dt. ________ to the P.O.

(7) Payment of the price for the material supplied under this agreement shall as under:

(a) As per clause No. ________ of the Purchase Order and amendment letter No. ________ dt. ________ to the P.O.

(8) The deposit made by the Contractor under clause (2) will be returned to the contractor after due fulfillment of this agreement by them.

(9) If the contractor fail wholly or in part to fulfill this agreement, the Purchaser shall be entitled at his discretion to retain the whole or any part of the deposit made by the contractor under clause (2) and if the loss suffered by the Purchaser exceeds the amount of said deposit, he will be entitled to recover the said loss from the Contractors.

(10) If any sum remains due or becomes recoverable from the contractor on account of the non-fulfillment of this agreement or on account of any other reason, the contractor shall pay the same immediately on demand, the Purchaser shall be entitled to recover the same from the contractor as arrears of Land Revenue.

(11) In witness of the due execution of this agreement the parties have hereunder set their hands the day and the year first above written.
Signed and delivered by

In case of Limited/Partnership Shri___________    (1)Signature
Companies & Firms Designation                   (2)Signature

For and on behalf of ___________________________ (1)Signature
In presence of witnesses                        (2)Signature

Signed and delivered by
In case of individuals Shri____________________ (1)Signature

Signed and delivered by
In case of Individuals Shri____________________ (1) Signature

In the presence of witness:

(1) Shri________________ Designation            (1) Signature
(2) Shri __________________ Designation          (2) Signature

Signed and delivered by the ___________________ RSDCL by order and on behalf of the MD of the Company.

Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ.)
(Seal to be affixed)
This Indenture made at ______ on _____ this ___ day of the Month of __________ of the year ____________ between the Managing Director, Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ.) hereinafter referred to as the owner which expression unless the context does not permit includes his successors and assigns) of the one part and

(I) To be used in case of Limited Companies

Messers_________________________ a private/Public Limited Company incorporated___________________ under the _____________________ companies act and having its Registered office at _____________________ (hereinafter referred to as Contractors/ Suppliers which expression unless the context does not permit includes their successors and permitted assigns).

(2) To be used in case of Partnership concerns

Messers __________________________ a Partnership Firm consisting of the following Partners namely:

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(hereinafter referred to as Contractor which expression unless the context does not permit includes their respective heirs, executors, administrators, legal representatives, permitted assigns) of the second part, witnessed as follows:-

(1) The contractors, does by these presents agree to execute the works to the owner and the owner does agree to get the works execute from the contractor, the material works specified in the Work order No. ___________ dated __________ and amendment letter No.________ dated __________ appended and on the terms & conditions contained in the said order and amendment letter. The General terms of the contract appended hereto are considered a part of this agreement.

(2) The Contractor has deposited Rs.______ (In words Rs.______________ only)

(a) *In cash, or
(b) *by furnishing a Demand Draft No.______ dated ______ drawn in favour of ________ or
(c) *by furnishing a Bank Guarantee equivalent to ___% of the Contract value, towards security deposit with the owner for the performance of this agreement by the contractor. The security deposit Receipt duly endorsed in favour of the owner should be lodged to his safe custody.

(d) The contractor has not deposited any amount either in Cash or by furnishing Demand Draft/ Bank Guarantee towards Security deposit but has agreed to accept ______% payment of each consignment as per stipulation (specified in clause relating to “Terms of Payment” of the Work Order).
(e) The contractor has agreed to deduct the amount Rs. _____ equivalent to _____% of the contract value from their first works bill(s) towards Security deposit as per stipulations of the Work Order.

(* delete whichever is not applicable)

(3) The Specifications of the execution of works to be executed under this agreement shall be as set forth in the Schedule referred to above.

(4) (a) The Contractor is to execute the work order:-

(i) As per cost/prices ______ (as indicated in the work order)

(b) Cost/charges etc. which may be payable as per clause No. ______ of Work Order would be the owner's liability and if incurred would be to his account.

(c) If so required by the Owner, the contractor will book the consignments by Rail/ Road to any destination stipulated by the Owner.

(d) In case the consignments are to be insured to cover risks in transit, such insurance charges, if payable would be to the contractor's account.

(e) The Purchaser shall reimburse to the Contractor all such expenditure, if any, that may be incurred by the contractor in this behalf under sub-clause (b),(c) and (d) of this clause as per provisions of contract by payment from time to time on receipt of the bills from the contractor supported by receipt or acknowledgement granted by Owner for works completed.

(5) In case of dispute as to whether any execution of work are or are not in accordance with specifications set-forth in the schedule, the decision of the Director(tech) RSDCL shall be final and binding on both the parties.

(6) The completion shall be effected and completed as per clause No. ______ of the Work Order from the date of this Work Order and amendment letter No. ______ dt._______. The commencement of works will be as per clause No. ______ of the W.O. and amendment letter No. ______ dt. ______ to the Work Order.

(7) Payment of the price for the execution of works under this agreement shall be as under :

(a) As per clause No. __________ of the Work Order and amendment letter No. __________ dt ______ to the W.O.

(8) The contractor is also bound to fulfill all the conditions mentioned in the above work order.

(9) The work to be executed under this agreement shall be as per terms and conditions mentioned in the above work order.

(10) If the Contractor fails wholly or in part to fulfill this agreement, the Owner's shall be entitled at his discretion to retain the whole or any part of the deposit made by the Contractor under clause (2) and if the loss suffered by the owner exceeds the amount of said deposit, he will be entitled to recover the said loss from the Contractors.

(11) If any sum remains due or becomes recoverable from the Contractor on account of the non-fulfillment of this agreement or on account of any other reason, the Contractor shall pay the same immediately on demand. If the contractor does not make such payment on demand, the owner shall be entitled to recover the same from the Contractor as arrears of Land Revenue.

(12) In witness of the due execution of this agreement the parties have hereunder set their hands the day and the year first above written.
Signed and delivered by

In case of Limited/Partnership Shri__________ (1)Signature
Companies & Firms Designation (2)Signature

For and on behalf of ________________________ (1)Signature
In presence of witnesses (2)Signature

Signed and delivered by
In case of individuals Shri_______________ (1)Signature

Signed and delivered by
In case of Individuals Shri_________________ (1) Signature

In the presence of witness:

(1) Shri______________ Designation (1) Signature
(2) Shri ______________ Designation (2) Signature
Signed and delivered by the ________________ RSDCL, Jaipur by order and on behalf of the
Managing Director of the Company.

Rajasthan Solarpark Development Company Ltd. JAIPUR

(Seal to be affixed)
TRUST RECEIPT FOR PLANT, EQUIPMENT AND MATERIALS RECEIVED FROM RSDCL
UNDER CONTRACT NO..........DATED.........

We M/s. ___________________________ have been awarded a Contract
No. __________ dated __________ for ______________________________ by
RSDCL, Jaipur.

We do hereby acknowledge the receipt of the Plant, Equipment and Materials as are
fully described and mentioned under Document of title/RR/LR etc and in the Schedule
annexed hereto, which shall form an integral part of this receipt, as "Trustee" of RSDCL. The
aforesaid materials etc. so received by us shall be exclusively used in the successful performance
of the aforesaid contract and for no other purpose whatsoever. We undertake not to create any
charge, lien, or encumbrance over the aforesaid materials etc. in favour of any other person/
institution(s) Banks.

for M/s. _______________
(AUTHORISED SIGNATORY)
SEAL OF COMPANY

Dated:

Place:
PROFORMA OF AUTHORISATION LETTER

Rajasthan Solarpark Development Company Ltd. JAIPUR (RAJ).

REF.NO.

DATE

To,

M/s____________________

________________________

________________________.

Ref: Contract No.____________ dated _________ for _________ awarded by RSDCL

Dear Sir,

Kindly refer to Contract No. ______________ dated _________ for _________ you are hereby authorised on behalf of RSDCL, having its Registered Office at E-166, Yudhishtir Marg, Jaipur and its project at ______ to take physical delivery of materials/equipment covered under despatch Document/Consignment Note No.*__________ dated _____ and as detailed in the enclosed schedule for the sole purpose of successful performance of the aforesaid contract and for no other purpose, whatsoever.

(Signatory of Project Authority)**

Designation _________

Date _________

Encl: As above.

**To be signed not below the rank of G.M.

* Mention LR/RR No.
PERFORMA OF BID BANK GUARANTEE
(For Earnest Money)

(Bank Guarantee in lieu of 80% of earnest money on non-judicial Stamp Paper of Rajasthan Government worth Rs.100.00)

To,
The Managing Director,
Rajasthan Solarpark Development Company Ltd.,
JAIPUR (RAJ.)

1. Whereas …………………………(name of the Bidder) (hereinafter called “the Bidder”) has submitted its bid dated……………(date of submission of bid) for the construction of ……..(name of contract)(hereinafter called "the Bid”).

2. KNOW ALL PEOPLE by these presents that WE…………….(name of bank) of …………….(name of country), having our registered office at……………….. (addresses of bank) (hereinafter called "the Bank"), are bound unto………………… (name of Purchaser) (hereinafter called "the Purchaser") in the sum of Rs.*___________ for which payment will and truly to be made to the said Purchaser, the Bank binds itself, its successors, and assigns by these presents. Sealed with the Common Seal of the said Bank this………….day of …………….20…………

3. THE CONDITIONS of this obligation are:

(i) If the Bidder withdraws its Bid during the period of bid validity specified by the Bidder in the Bid Form; or

(ii) If the bidder refuses to accept the correction of error in his Bid; or

(iii) If the Bidder, having been notified of the acceptance of its Bid by the Purchaser during the period of bid validity:

(a) fails or refuses to execute the Contract Agreement, if required:

or

(b) fails or refuses to furnish the performance security, in accordance with the General Conditions of Contract.

4. We undertake to pay to the purchaser up to the above amount upon receipt of its first written demand, without the purchaser having to substantiate its demand, provided that in its demand the Purchaser will note that the amount claimed by it is due to it owing to the occurrence of one or all of the three conditions specifying the occurred condition or conditions.

5. The decision of the Managing Director, Rajasthan Solarpark Development Company Ltd, Jaipur shall be final whether breach has been committed on the right to demand the amount of guarantee from us which has accrued to the purchaser.

6. This guarantee shall not cease or determine, if the purchaser grants time or indulgence or vary the terms of the contract with the Contractor or without our consent or knowledge.

7. The guarantee herein contained shall not be affected by any change in the constitution of the Contractor.

8. We……………………….further undertake not to revoke this guarantee during its currency except with the previous consent of the MD, RSDCL.
9. All disputes arising under the said guarantee between the Bank and the Company or between the Contractor and the Company pertaining to the guarantee, shall be subject to the jurisdiction of Courts in Jaipur, Rajasthan alone.

10. This guarantee will remain in force up to and including one hundred eighty (180) days after the date of the opening of bids, i.e. up to ........................, with a further grace period of Ninety (90) days and any demand in respect thereof should reach the Bank not later than the above date.

Yours faithfully,

Bankers (EXECUTENT)

Signed by the above named Bank in presence of :-
(Signature with full Name and Address)

Witness :

1.___________________

2.___________________

Attested by Notary Public, First Class Magistrate or directly confirmed by the executing bank.

* The Bidder should insert the amount of the guarantee in words and figures denominated in the currency of bid. This figure should be same as shown in clause No.2.1 of the Special Conditions of Contract.

**Note:** In case the bid is submitted by a Joint Venture, the Bid Bank guarantee shall be in the name of Lead partner or in the name of joint venture partners submitting the Bid covering all the partners of the joint venture.
ANNEXURE-IX

PROFORMA FOR JOINT VENTURE AGREEMENT

(ON NON JUDICIAL STAMP PAPER OF APPROPRIATE VALUE TO BE PURCHASED IN THE NAME OF JOINT VENTURE)

PROFORMA OF JOINT VENTURE AGREEMENT BETWEEN..............................................................
AND........................................FOR BID SPECIFICATION No. ......................... OF RSDCL

This joint venture agreement executed on this ....................... day of ................................two thousand ..................... between M/s ................... a company incorporated under the laws of .............................and having its registered office at .....................(hereinafter called the “lead Partner” which expression shall include its successors, executors and permitted assigns), M/s ......................... a company incorporated under the laws of .............................and having its registered office at ...................... (hereinafter called the “Partner” which expression shall include its successors, executors and permitted assigns) and M/s ...................... a company incorporated under the laws of .................................. and having its registered office at .........................(hereinafter called the “Partner” which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract (in case of award) against the Specification No. .................... for construction of 220kV Pooling Stations on turnkey basis with RSDCL. (hereinafter called the “purchaser”).

WHEREAS the purchaser invited bids as per the above mentioned specification for the manufacture, supply of equipment/materials stipulated in the bidding documents under subject package for construction of 220kV Pooling Stations on turnkey basis.

AND WHEREAS clause 2.0, ITB, Volume-I (Qualifying requirements for bidders) forming part of the bidding documents, inter-alia stipulates that a Joint venture of two qualified manufacturers/contractors as partners, meeting the requirements of Clause 2.0, ITB, Volume-I as applicable may bid, provided the Joint Venture fulfills all other requirements under Clause 2.0, ITB, Volume-I (Qualifying requirements for bidders) and in such a case, the Bid Proposal Form shall be signed by all the partners so as to legally bind all the partners of the joint venture, who will be jointly and severally liable to perform the contract and all obligations hereunder.

The above clause further states that the Joint Venture agreement shall be attached to the bid and the contract performance guarantee will be as per the format enclosed with the bidding document without any restrictions or liability for either party.

AND WHEREAS the bid has been submitted to the Purchaser vide proposal No. ..................... dated .................. by Lead partner based on the Joint Venture agreement between all the partners under these presents and the bid in accordance with the requirements of clause 2.0, ITB, Volume-I (Qualifying requirements for bidders) has been signed by all the partners.
NOW THIS INDENTURE WITNESSETH AS UNDER:

In consideration of the above premises and agreements all the partners to this Joint Venture do hereby now agree as follows:

1. In consideration of the award of the contract by the purchaser to the Joint Venture partners, we, the partners to the Joint Venture agreement do hereby agree that M/s ...................... shall act as Lead Partner and further declare and confirm that we shall jointly and severally be bound unto the Purchaser for the successful performance of the contract and shall be fully, responsible for the design, manufacture, supply, construction, testing, commissioning, handholding of 220kV Pooling Stations on turnkey basis and successful performance of the material/equipments in accordance with the contract.

2. In case of any breach of the said contract by the Lead Partner or other partner(s) of the Joint Venture agreement, the partner(s) do hereby agree to be fully responsible for the successful performance of the contract and to carry out all the obligations and responsibilities under the contract in accordance with the requirement of the contract.

3 Further, if the purchaser suffers any loss or damage on account of any breach in the contract or any shortfall in the performance of the Equipments/material in meeting the performances guarantees as per the specification in terms of the Contract, the partner(s) of these presents undertake to promptly make good such loss or damages caused to the Purchaser, on its demand without any demur. It shall not be necessary or obligatory for the Purchaser to proceed against Lead Partner to these presents before proceeding against or dealing with other Partner(s).

4. The financial liability of the Partners of this Joint Venture agreement to the Purchaser, with respect to any of the claims arising out of the performance or non-performance of the obligations set forth in the said Joint Venture agreement, read in conjunction with the relevant conditions of the contract shall, however, not be limited in any way so as to restrict or limit the liabilities of any of the partners of the joint venture agreement.

5. It is expressly understood and agreed between the partners to this joint venture agreement that the responsibilities and obligations of each of the partners shall be as delineated in separate Appendix (“To be incorporated suitably by the Partners) to this agreement. It is further agreed by the Partners that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and several responsibilities of the partners under this contract.

6. This Joint Venture agreement shall be construed and interpreted in accordance with the laws of India and the courts of Jaipur shall have the exclusive jurisdiction in all matters arising there under.

7. In case of an award of a contract, we the partners to the Joint Venture agreement do hereby agree that we shall be jointly and severally responsible for furnishing a contract performance security from a bank in favour of the purchaser in the currency of the contract.

8. It is further agreed that the Joint Venture agreement shall be irrevocable and shall form an integral part of the contract, and shall continue to be enforceable till the purchaser discharges the same. It shall be effective from the date first mentioned above for all purposes and intents.

IN WITNESS WHEREOF, the partners to the Joint Venture agreement have through their authorised representatives executed these presents and affixed common seals of their companies, on the day, month and year first mentioned above.
| 1. Common seal of ............ has been affixed in my/our presence pursuant to the Board of Director's Resolution dated ............ | For Lead Partner (Signature of authorised representative) |
| Name .................................. Designation.................................. Common Seal of the Company |
| Signature .................................. Name .................................. Designation .................................. |

| 2. Common seal of ............ has been affixed in my/our presence pursuant to the Board of Director’s Resolution dated ............ | For other Partner (Signature of authorised representative) |
| Name .................................. Designation.................................. Common Seal of the Company |
| Signature .................................. Name .................................. Designation .................................. |

WITNESSES
1. .................................. (Signature) .................................. (Signature) ..................................
   (Official address) .................................. (Official address) ..................................
ANNEXURE-X

FORM OF POWER OF ATTORNEY FOR JOINT VENTURE

(On Non-judicial Stamp Paper of Appropriate value to be Purchased in the name of Bidder)

KNOW ALL MEN BY THESE PRESENTS THAT WE, the Partners whose details are given hereunder____________________ have formed a Joint Venture under the laws of __________ and having our Registered Office/Head Office at ____________________________ (hereinafter called the “Joint Venture”) which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) acting through M/s________________ a Company incorporated under the laws of __________________________ and having its Registered/Head office at ____________________________ as our duly constituted lawful Attorney (hereinafter called “Attorney” or “Authorised Representative” or “Partner Incharge”) to exercise all or any of the powers for and on behalf of the Joint Venture in regard to specification No. __________ Package __________, the bids for which have been invited by RSDCL Jaipur, (Rajasthan) (hereinafter called the “Purchaser”) to undertake the following acts:

i) To submit proposal and participate in the aforesaid Bid Specification of the Purchaser on behalf of the “Joint Venture”.

ii) To negotiate with the Purchaser the terms and conditions for award of the Contract pursuant to the aforesaid Bid and to sign the contract with the Purchaser for and on behalf of the “Joint Venture”.

iii) To do any other act or submit any document related to the above.

iv) To receive, accept and execute the Contract for and on behalf of the “Joint Venture”.

It is clearly understood that the Partner Incharge shall ensure performance of the Contract(s), the same shall be deemed to be a default by all the Partners.

It is expressly understood that this Power of Attorney shall remain valid binding and irrevocable till completion of the guarantee period in terms of the Contract.

The Joint Venture hereby agrees and undertakes to ratify and confirm all the whatsoever the said Attorney/Authorised Representative quotes in the Bid, negotiates and signs the contract with the Purchaser and/or proposes to act on behalf of the Joint Venture by virtue of this Power of Attorney and the same shall bind the Joint Venture as if done by itself.

IN WITNESS THEREOF the Partners Constituting the Joint Venture as aforesaid have executed these presents on this __________ day of __________ under the Common Seal(s) of their Companies.

For and on behalf of the
Partners of Joint Venture
____________________
____________________
____________________

THE COMMON SEAL OF THE ABOVE PARTNERS OF THE JOINT VENTURE:

THE COMMON SEAL HAS BEEN AFFIXED THERE UNTO IN THE PRESENCE OF:

WITNESS

1. SIGNATURE__________ 2. SIGNATURE__________
NAME_________________ NAME_________________
DESIGNATION____________ DESIGNATION____________
OCCUPATION____________ OCCUPATION____________
RAJASTHAN SOLAR PARK DEVELOPMENT COMPANY LTD.

VOLUME-II

TECHNICAL SPECIFICATION

NO: RSDCL/D(T)/SP/NOKH/PPS/TK/TN-03 (2019-20)

(FOR SUB-STATION EQUIPMENTS)

FOR

CONSTRUCTION OF 4 NOS. 220/33 KV, PARK POOLING

SUB-STATIONS

AT

NOKH SOLAR PARK ON TURNKEY BASIS
## TECHNICAL SPECIFICATION FOR SUB-STATION EQUIPMENTS FOR CONSTRUCTION OF
4Nos. 220/33KV PARK POOLING STATIONS AGAINST TN-03 (2019-20)

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### TECHNICAL SPECIFICATION OF VARIOUS EQUIPMENTS

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## SPECIFICATIONS FOR SWITCHYARD ERECTION TESTING & COMMISSIONING

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TECHNICAL SPECIFICATION FOR CONSTRUCTION OF 4 NOS. 220/33 KV PARK POOLING STATIONS ON TURNKEY BASIS AGAINST TN-03 (2019-20).

SECTION-I

1.0 SCOPE:

1.1 This section covers the basic technical requirements in respect of Design, Engineering, Supply of material/equipments for construction of 4Nos. 220 KV Park Pooling Sub-stations at Nokh, Jaisalmer along with installation, erection, testing & commissioning of the same and execution of Civil works as per specification & RSDCL’s layout design on turnkey basis.

All the design, engineering and drawings for construction, testing & commissioning of 220/33KV Sub-stations shall be in bidder’s scope. The bidder shall quote their proposals strictly conforming to the technical specification details, design as specified in this specification. Any offer based on the alternate design shall not be considered.

The equipments to be supplied, erected & commissioned against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipments as well as the erection, testing & commissioning work shall therefore be of the highest order to ensure continuous and trouble free service over the years. The items/equipments to be supplied shall be new & complete with all parts, accessories necessary for their effective, trouble-free operation. Such parts, accessories will be deemed to be within the scope of the bidder, irrespective of whether they are specifically indicated in the commercial/technical specifications, order or not.

2.0 SALIENT FEATURES OF 220/33KV PARK POOLING SUB-STATIONS:

(I) DESIGN PARAMETERS:

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<tr>
<td>(2) Highest system voltage</td>
<td>245KV</td>
<td>36KV</td>
</tr>
<tr>
<td>(3) System Short Circuit Current</td>
<td>40.0 KA</td>
<td>31.5 KA</td>
</tr>
<tr>
<td>(4) BIL</td>
<td>1050KVP</td>
<td>170 KVP</td>
</tr>
<tr>
<td>(5) One Minute Power Frequency voltage</td>
<td>460KV</td>
<td>70 KV rms</td>
</tr>
<tr>
<td>(6) Creepage Distance (Min.) (25mm/KV)</td>
<td>6125mm</td>
<td>900 mm</td>
</tr>
<tr>
<td>(7) Frequency Variation</td>
<td>--------------------+/- 3%</td>
<td></td>
</tr>
<tr>
<td>(8) Voltage variation</td>
<td>--------------------+/- 10%</td>
<td></td>
</tr>
<tr>
<td>(9) Earthing</td>
<td>-------------------- Solidly Earthed</td>
<td></td>
</tr>
</tbody>
</table>

(II) BUS ARRANGEMENT:

1. 220 KV Main-I & Main-II Bus: Twin AL-59 (Moose equivalent) conductor.
2. 220kV Transfer Bus: Single AL-59 (Moose equivalent) conductor.
3. 33 KV Main Bus: Twin Tarantula conductor.
4. 33kV Auxiliary Bus: Single Tarantula conductor.

(III) AUXILIARY SUPPLY:

The sub-station auxiliary supply is normally met through a system having the following parameters. The auxiliary power for station supply, including the equipment drive, lighting etc. shall be designed for the specified parameters as under. The DC supply for the instrumentation and PLCC system shall also confirm the parameters as indicated in the following table:
<table>
<thead>
<tr>
<th>Normal Voltage</th>
<th>Variation in Voltage</th>
<th>Frequency in Hz.</th>
<th>Phase/Wire</th>
<th>Neutral Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>415V</td>
<td>+ 10%</td>
<td>50 + 5%</td>
<td>3/4 wire</td>
<td>Solidly Earthed</td>
</tr>
<tr>
<td>240V</td>
<td>+ 10%</td>
<td>50+ 5%</td>
<td>1/2 wire</td>
<td>Solidly Earthed</td>
</tr>
<tr>
<td>220V</td>
<td>190V to 240V</td>
<td>DC</td>
<td>--</td>
<td>Isolated 2-wire system</td>
</tr>
<tr>
<td>50V</td>
<td>-</td>
<td>DC</td>
<td>--</td>
<td>2 wire system (+) Earthed</td>
</tr>
</tbody>
</table>

Combined variation of voltage and frequency shall be limited to + 10%.

(IV) SAFETY CLEARANCE:

220KV 33KV
4600 mm 2800 mm

“Safety clearance” is the minimum clearance to be maintained in air between the live part of
the equipment on one hand and earth or another piece of equipment or conductor (on which
it is necessary to carry out the work) on the other.

(V) GROUND CLEARANCE: For safety of personnel moving in the switchyard with tools and
Plant.

220KV 132KV 33KV
5500mm 4600mm 3700mm

3.0 CLIMATIC CONDITIONS:

Equipment to be supplied against this specification shall be suitable for satisfactory
operation under the following tropical conditions:

(a) Max. ambient air temperature in shade : 50 degree C.
(b) Min. Temp. of air in shade : (-) 5 degree C.
(c) Maximum relative humidity : 100%.
(d) Minimum relative humidity : 10%.
(e) Altitude above MSL varies from : 61 M to 815 M
(f) Dust storms are liable to occur during period from
   : March to July.
(g) Average number of thunder storm days per annum. : 40
(h) Average No. of tropical monsoon (conditions) Per annum : 4 Months (June to Sept.)
(i) Average annual rain fall : 10 cm to 100 cm.
(j) Mean annual temperature : 32 degree C.
(k) Max. Wind pressure : 195 Kg/Sq. M.
(l) Seismic level (Horizontal acceleration) : 0.3g.
(m) Degree of Pollution : Heavy

4.0 STANDARDS:

All the items/equipments to be designed, supplied and erected/commissioned against this
specification shall conform to the latest revision of the following standards. However, the
relevant standards to which the individual equipment shall confirm have also been listed
under the technical specification of particular equipment.

1. Aluminium conductor for overhead Transmission purposes (ACSR/AAAC) -IS 398
2. Conductor and earth wire accessories for overhead power lines. -IS 2121(Pt.I-III)
3. Design and construction of foundations for transmission line towers and poles. - IS 4091
4. Hot-dip galvanising coatings on round steel wires - IS 4826
5. Hot-dip galvanising coatings on structural steel and allied products. - IS 4759
6. Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V. - IS 731
7. Solid core insulators - IS 2544, IS 5350 & IS 13134
8. Method of testing uniformity of coating on zinc coated articles. - IS 2633
9. Recommended practices for hot-dip galvanising of Iron & steel. - IS 2629
10. Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V. - IS 2486 (Part: I-IV)
11. Code of practice for use of structural steel in overhead Transmission lines. - IS 802 (Pt I-III)
12. Rolled steel, beams, channel and angle sections. - IS 808
13. Technical supply conditions for nuts and threaded fasteners (1st revision). - IS 1367
14. Specifications for high tension structural steel. - IS 961
15. Hexagonal bolts for steel structures - IS 12427
16. Specification for washers:
   a) spring - IS 6735
   b) plain - IS 2016
   c) heavy - IS 6610
17. Dimensions for clearance holes for metric bolts - IS 1821
18. Specification for hot-dip galvanised coatings on fasteners. - IS 1367 (Part-III)
19. Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purpose. - IS 5082
20. Terminal connector/Electric Power connector - IS 5561
21. Supply of pipes and tubes. - IS 1239
22. Dimensions for wrought aluminium and aluminium alloy tubes:
   a) drawn type - IS 2678
   b) extruded type - IS 2673
24. Degree of protection provided for enclosures for low voltage switchgear and control gear. - IS 2147
25. Specification for 3 phase induction motor - IS 325 & IS 996
26. High pressure cylinder in which SF6 gas is transported and stored at site. - IS 4379, IS 7311
27. Specification for current Transformers. - IS 2705
28. Specification for high voltage porcelain bushings. -IS 2099/3347/8603 & IS 60044-1
29. Method of high voltage testing. -IS 2071
30. Insulation co-ordination of highest voltages for equipments of 100 KV and above. -IS 2165
31. Specification for new Insulating oil -IS 335
32. Specification for voltage transformer. -IS 3156
33. Code of practice for climate-proofing of electrical equipment. -IS 3202
34. Specification for Alternating current isolators (dis-connectors) and earthing switches. -IS 9921
35. Specification for marking and arrangement for switchgear, bus-bar main connection & auxiliary wirings -IS 375
36. Specification for surge arresters without gap for AC system. -IEC 99-4
37. Specification for hollow porcelain bushing -IS 55621/IS2099
39. Specification for synthetic separators for lead-acid batteries. -IS 6071
40. Specification for hard rubber containers for lead-acid storage batteries. -IS 1146
41. Specification for sulphuric acid -IS 366
42. Specification for water for storage batteries. -IS 1069
43. Specification for sealing compound for lead acid batteries. -IS 3116
44. Specification for rectifier equipment in general. -IS 3895
45. Specification for HRC fuses. -IS 9224
46. General requirement of indicating & integrating meters -IS 1248
47. Specification for mono-crystalline semi-conductor rectifier assemblies and equipments. -IS 4540
48. Specification for transformers. -IS 2026
49. Specification for printed circuit boards. -IS 5921
50. Specification for AC contactors for voltage not exceeding 1000 V -IS 2959
51. Specification for Air break switches and fuse combination units. -IS 4064
52. Specification for colour for ready mix paints & enamels. -IS 5
53. Safety code for semiconductor rectifier equipment. -IS 6619
54. General requirement for switchgear and control gear for voltage not exceeding 1000 V -IS 4237
55. Specification for Protective relays -IS 3231
56. Specification for static protective relays. -IS 8686
57. Dimensions of mechanical structures of the 19"(482.6 mm) series. - IEC 297
58. Specification for Energy meters control switches. - IS 722
59. Specification for PVC insulated (Heavy duty) electric cables for working voltage up to and including 1100 Volts. - IS 1554 (Pt.-I)
60. Code of practice for phosphating iron and steel. - IS 6005
61. Metal clad indoor switchgear. - IS 12729
62 Specification for ON load Tap changer - IS 8468
63 Specification for Gas & oil operated relay. - IS 3637
64 Fitting & accessories of power Transformer. - IS 3639
65 Guide for loading of oil immersed Transformer. - IS 6600
66 Seamless high carbon steel cylinders for permanent & high pressure liquefiable gas. - IS 7285
67 Bushing for AC voltage - IEC-137.
68 Specification and acceptance of new supply of SF6. - IS IEC-376
69 Making & arrangement for switchgear Bus bar main connections & auxiliary wiring. - IS 5578 & 11353
70 Conductors for Insulated electric cable & flexible cords. - IS 8130
71 PVC Insulation & sheath of electric cable - IS 5831
72 Current rating for cables. PVC insulated & PVC sheath heavy duty cables. - IS 3961 (Part-II)
73 Reactors - IS 5553
74 Fuse (external) - IS 9402
75 Fuse (internal) - IS 12672
76 Specification for Shunt capacitor for AC power system having rated voltage above 1000V. - IS 13925
77 Electrical coating of zinc & iron steel - IS 1573
78 Testing of Silver Plating thickness - BS 2616
79 Recommended practice for silver plating for general engineering purpose. - IS 5925, IS 9530
80. Application guide for voltage transformer - IS 4056/IS 4146
81 Specification for integrating instruments - IS 13779
82 Specification for low voltage switchgear & control gear assemblies - IS 8623
83 Specification for low voltage switchgear & control gear(covers degree of protection) - IS 13947
84 Application guide for current Transformers - IS 4201
85 Dimensions of terminals for higher voltage switchgear & control gear - IS 10601
86 Specification for structural steel - IS 2062
87 Specification for galvanized steel wire - IS 12776
88 Method of impulse voltage testing - IS 2070
89 Specification for code practice for installation & maintenance of transformers - IS 1886
90 Specifications for fans - IS 2312
91 Application guide for capacitor voltage Transformer - IS 5547

Dimensions of porcelain transformer Bushing - IS 3347 (part-III)
Specification for coupling capacitor & capacitor divider - IS 9348

4.1 The equipments/work covered under this specification shall also comply with the requirements of the latest Electricity Act and the Indian Electricity Rules and any other applicable statutory provisions, rules and regulations.

5.0 REQUIREMENT AND QUANTITY:

5.1 The scope and quantity of work covered in this specification are broadly indicated in the in the scope of works. The works involved comprise of the following:

(A) Design, engineering, testing at the manufacturer’s works and supply of all materials /equipments as specified in BOM required for the 220/33 KV Pooling sub-stations.

(B) Supply of materials and execution of Civil works as specified in the specification Vol.-II & III and BoM, including foundations, earthmat laying, along with construction of cable trenches, Control Room Building (including electrification), boundary wall, roads, Guard hut, Store shed, parking, GLR, water harvesting, Dormitory etc. within the sub-stations & Electrification in Sub-stations.

(C) Successful Erection, Testing and commissioning of all Sub-station equipments.

5.2 Item wise quantities required for 220/33KV switchyard works are indicated in the Bill of Materials (BoM). The same shall be checked by the bidder. Discrepancy, if any in it, shall be intimated by the bidder to the RSDCL immediately. The Bill of Materials shall be considered as the datum for preparation of bids for Park Pooling station works. In case, there are any changes in quantity/scope (during execution) vis-à-vis in the Bill of Materials, the price implication (addition/deletion) shall be worked out by operating the unit rates. As such, unit rates of all the items, including various connectors and fixtures for indoor/outdoor installation & those items which are not listed in BoM but are required essentially for completion of 220/33KV Park Pooling stations, as per specification shall be made available by bidder in the offer.

5.3 Other items/material required for construction of Park Pooling stations which are not listed out in the Bill of Materials but are required for the completion of the project, such material/items shall deemed to be included in the scope of bidder.

5.4 The weight of structures is available in the specification so as to enable the bidder to work out the cost estimates thereof based on BoM. The supporting structures for Circuit Breakers are to be supplied along with the Circuit Breakers.

6.0 DRAWINGS AND DATA:

6.1 The electrical drawings indicating the Layout plan of the proposed 220/33KV Park Pooling Sub-stations and the Earthmat (indicative) are enclosed in the specification of Civil Works Volume-III. All the items & equipments indicated in the drawings, unless otherwise stated shall be considered covered in the bidder’s scope.

6.2 Earthmat design: The earthmat drawing (indicative) of proposed Pooling Sub-stations is enclosed in the specification of Civil works Volume-III. The bidder shall develop the drawings as per actual requirement, in consultation with RSDCL and arrange laying of Earthmat as per the actual approved drawing. The equipment earthing and connection to the earthmat will be in the bidder’s scope. The constructional details for laying are enclosed in this specification.
6.3 The drawings of switchyard structures and equipments structures namely CTs, CVT, PT, LAs, Isolators etc shall be provided by RSDCL.

6.4 Detailed design/drawing of Control Room Building & Dormitory is indicated in specification of Civil Works, Vol.III. All such materials shall be procured as per these drawings.

6.5 The switchyard is designed for a Short Circuit level of 40 KA for 220KV side and 31.5 KA for 33KV side. Accordingly, the power connectors and hardwares shall be suitable for withstanding the Short Circuit current level as specified.

7.0 PRINCIPLE TECHNICAL PARTICULARS:

7.1 The principle technical particulars & specification in respect of the various equipments, items, lighting items to be supplied & earthing specification are available in Section-II of this Volume. The general technical specification for switchyard, bay equipment erection, testing & commissioning are available at Section-III of this Volume.

7.2 DRAWINGS FOR APPROVAL (FOR MATERIAL, EQUIPMENTS & WORKS):

The successful bidder shall submit all the relevant drawings for approval within 30 days from the date of issue of letter of Intent (LOI)/Award (LOA). These drawings shall be submitted to the Purchaser in 3 copies. The approval/comments on the drawings will normally be conveyed within 4 weeks from the date of submission/receipt of drawings whichever is later. Four sets of the revised drawings shall be supplied by the contractor i.e. 3 sets to Director (Technical) and one set to the consignee.

7.3 CONTRACTUAL DRAWINGS AND MANUALS:

The contractor shall supply 4 sets of all final (approved) as built drawings along with one set of PVC reproducibles for RSDCL's future reference. These drawings and reproducibles shall incorporate all the corrections/ modifications, if any, carried out during and/or after drawing approval. The contractor shall furnish 3 sets of commissioning and maintenance instruction manuals in respect of each of the equipment supplied by him against this contract. These manuals shall be supplied in neatly bound volumes. Out of above, 2 sets of all above drawings & manuals shall be supplied to the consignee.

8.0 COMPLETION PERIOD:

All the works including supply of material/equipments, its erection, testing & commissioning and execution of Civil works against this specification shall be completed as per specification. Time being the essence of the contract, timely completion of the work is imperative. Any delay in completion will lead to recovery from the defaulter as indicated in GCC, Volume-I.

9.0 UNIT RATES:

The bidder shall quote the unit rates of each of the equipment/item and material included in the scope of supply. Any item which is not specifically listed out in the BoQ but is required for completion of the works shall be in the scope of contractor. Unit rates shall also be quoted for Erection, Testing and commissioning of each item/material as per BoQ.

Similarly, unit rates of all the Civil works to be carried out as per specification at sub-stations must be quoted by the bidders in relevant Schedules for Civil works enclosed with the specification.
10.0 TYPE TESTS:

10.1 Each equipment/item offered for supply against this specification shall be of a design which is already type tested as per the latest relevant standards and the requirements specified in this specification.

10.2 In the event of Order, the Contractor shall furnish the Original/attested Photostat copies of the latest type test certificates from a Govt./Govt. approved/Govt. recognized/NABL Accredited test Laboratory/ILAC i.e. International Laboratory Accreditation Co-operation (in case of foreign laboratories) or the certificate of type test conducted at manufacturer’s works dully witnessed by representative of any Electricity Board/Electricity Company/ Govt. Agency/PGCIL/NTPC (wherever specified in Technical Specification for particular item) or the certificate of type test conducted in the manufacturer’s own lab located in the foreign Country duly witnessed by independent Agency for all the type tests wherever prescribed in the relevant latest editions of Indian Standards/International Standards (as applicable in terms of Section-II, Volume-II, of this specification). The type test certificates should not be older than seven years as on the date of Technical bid opening for which the date of conducting of test shall be considered. However, no separate type test charges shall be paid to the bidder.

10.3 Type test reports as per Clause 10.2 above for equipments/items manufactured by any of the approved vendors need not be submitted along with the offer, provided that an undertaking is furnished to submit type test reports, if already conducted, for approval of the RSDCL at the time of drawing approvals of the equipments, or to conduct the type tests in the presence of RSDCL’s representative and submit it before dispatch of the equipments. Any delay on account of furnishing type test reports shall not be considered for extension in completion period of the project.

10.4 If the type tests are more than seven year old then the bidder has to arrange for type testing the equipment/item at no extra cost to the RSDCL.

10.5 In the case of Control & Relay Panels, the type tests clauses as above are mainly applicable for protective relays.

10.6 Not-withstanding anything stated above, the RSDCL’s decision regarding type tests will be final and binding on the bidder.

11.0 INSPECTION:

Unless waived, the inspection of materials at the respective manufacturer’s works will be done in presence of the RSDCL’s representative and the dispatch clearance will be issued, if the materials are found to be in order.

12.0 CIVIL WORKS OF 220/33 KV PARK POOLING SUB-STATIONS:

Civil works of proposed 220/33 KV Park Pooling Sub-stations including Dormitory shall be carried out by the contractor as per specification Volume-III titled “Specification for Civil works” attached with the specification.

13.0 DEVIATIONS FROM SPECIFICATION:

In case, the bidder desires to deviate from this specification on any account, the details of such deviations along with the reasons and justifications thereof shall be brought out clearly in the Schedule of Deviations (Schedule V). Unless brought out specifically in the schedule of Deviations, the offers shall be treated to be conforming to the requirements of the specification in all respects.
14.0 GUARANTEE PERIOD OF EQUIPMENTS/MATERIAL:

The guarantee period of individual item/equipment/material to be supplied against this contract shall be as per the period mentioned in the specification of that particular item/equipment, if specified. For rest of the items, the guarantee period shall be 12 Months from the date of its commissioning or 18 Months from the date of receipt of its last consignment at site, whichever is earlier.

15.0 BILL OF MATERIAL FOR CONSTRUCTION OF 4 NOS. 220/33 KV PARK POOLING STATIONS (PPS) AT NOKH, JAISALMER:

Annexure-I

<table>
<thead>
<tr>
<th>S. No</th>
<th>Particulars</th>
<th>Unit</th>
<th>Quantity required for</th>
<th>Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>PPS-1</td>
<td>PPS-2</td>
</tr>
<tr>
<td>1</td>
<td>Structures/Beams with Nuts, Bolts &amp; Washers etc. complete</td>
<td></td>
<td>4</td>
<td>5</td>
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<tr>
<td>1.01</td>
<td>AT1</td>
<td>Nos</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>1.02</td>
<td>AT3</td>
<td>Nos</td>
<td>3</td>
<td>4</td>
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<td>AT4</td>
<td>Nos</td>
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<td>AT6</td>
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<td>AT8</td>
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<tr>
<td>1.06</td>
<td>AB1/2 Beam</td>
<td>Nos</td>
<td>26</td>
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<tr>
<td>1.07</td>
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<td>1.09</td>
<td>AO3</td>
<td>Nos</td>
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<td>39</td>
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<td>1.10</td>
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<td>Nos</td>
<td>18</td>
<td>24</td>
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<td>1.11</td>
<td>AO-5 type (For 220kV LA)</td>
<td>Nos</td>
<td>18</td>
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<tr>
<td>1.12</td>
<td>Wave trap structure</td>
<td>Nos</td>
<td>4</td>
<td>6</td>
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<tr>
<td>1.13</td>
<td>PIS type</td>
<td>Lot</td>
<td>1</td>
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<tr>
<td>1.14</td>
<td>X-15 for 33 KV Isolator</td>
<td>Nos</td>
<td>58</td>
<td>58</td>
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<tr>
<td>1.15</td>
<td>33 KV CT/ PT Structure</td>
<td>Nos</td>
<td>26</td>
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<tr>
<td>1.16</td>
<td>XYZ (Y-without Stub)</td>
<td>Nos</td>
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<td>1.17</td>
<td>XY</td>
<td>Nos</td>
<td>16</td>
<td>16</td>
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<td>1.18</td>
<td>Y with stub</td>
<td>Nos</td>
<td>20</td>
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<tr>
<td>1.19</td>
<td>GF 5.4m type beam</td>
<td>Nos</td>
<td>24</td>
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<td>2</td>
<td>Outdoor Equipments</td>
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<td></td>
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<tr>
<td>2.01</td>
<td>220 KV/33 KV, 100 MVA Power Transformer with all accessories &amp; 5% extra oil</td>
<td>Nos</td>
<td>3</td>
<td>3</td>
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<tr>
<td>2.02</td>
<td>Nitrogen Injection Based Fire Protection System for 100 MVA Transformer and 25 MVAR Reactor</td>
<td>Nos</td>
<td>4</td>
<td>4</td>
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<tr>
<td>2.03</td>
<td>220 kV Bus bar Reactor of 25 MVAR</td>
<td>Nos</td>
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<td>2.04</td>
<td>220 KV Circuit Breaker with mounting structure, 2000 Amp, 40 kA, 3 Sec.</td>
<td>Nos</td>
<td>8</td>
<td>9</td>
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<tr>
<td>2.05</td>
<td>220 KV Isolator without Earth Blade 2000 Amp (motor operated &amp; double break type) 40 kA, 3 Sec.</td>
<td>Nos</td>
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<td>Description</td>
<td>Nos</td>
<td>2</td>
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<td>2.06</td>
<td>220 KV Isolator with Single Earth Blade 2000 Amp (motor operated &amp; double break type) 40 kA, 3 Sec.</td>
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<td>2.07</td>
<td>220 KV Isolator with Double Earth Blade 2000 Amp (motor operated &amp; double break type) 40 kA, 3 Sec.</td>
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<td>8</td>
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<td>2.08</td>
<td>220 KV Tandem isolator 2000 Amp (motor operated &amp; double break type) 40 kA, 3 Sec.</td>
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<td>220 KV Current Transformer: 500-1000/1A, 0.2 class, 40 kA, 1 Sec.</td>
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<td>39</td>
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<td>2.10</td>
<td>220 KV Capacitor Voltage Transformer (CVT), 0.2 class including metering CVT</td>
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<td>18</td>
<td>24</td>
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<tr>
<td>2.11</td>
<td>198 KV Lightning Arrester</td>
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<td>21</td>
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<tr>
<td>2.12</td>
<td>220 KV Post Insulators (including for Isolators)</td>
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<tr>
<td>2.13</td>
<td>220 KV Marshalling Kiosk</td>
<td></td>
<td>9</td>
<td>10</td>
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<tr>
<td>2.14</td>
<td>33 KV Current Transformer: 2400 / 1A, 0.2S, 1 Sec.</td>
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<td>24</td>
<td>24</td>
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<td>2.15</td>
<td>33 KV Current Transformer: 500-1000 / 1A, 0.2S, 1 Sec.</td>
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<td>36</td>
<td>36</td>
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<tr>
<td>2.16</td>
<td>33 KV CT/PT Junction Box</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2.17</td>
<td>30 KV Lightning Arrester</td>
<td></td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>2.18</td>
<td>33 KV Marshalling Kiosk</td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2.19</td>
<td>33 KV Vacuum circuit breaker with mounting structure, 2500 Amp, 31.5 kA, 3 Sec</td>
<td></td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2.20</td>
<td>33 KV Vacuum circuit breaker with mounting structure, 1250 Amp, 31.5 kA, 3 Sec</td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2.21</td>
<td>33 KV Potential Transformer (110 V)</td>
<td></td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>2.22</td>
<td>33KV Isolator without Earth Blade 2500 Amp, 31.5 kA, 1 Sec</td>
<td></td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>2.23</td>
<td>33KV Isolator with single Earth Blade 2500 Amp, 31.5 kA, 1 Sec</td>
<td></td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>2.24</td>
<td>33KV Isolator without Earth Blade 1250 Amp, 31.5 kA, 1 Sec</td>
<td></td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2.25</td>
<td>33KV Isolator with single Earth Blade 1250 Amp, 31.5 kA, 1 Sec</td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2.26</td>
<td>2*24 KV PI or 36 kV PI</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.27</td>
<td>33/0.4 KV, 250 KVA Station Transformer</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.28</td>
<td>11/0.4 KV, 100 KVA Station Transformer (For alternate Aux. supply from DISCOM)</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.29</td>
<td>33 KV H.G. Fuse (Set for 3 phases) with supporting structures</td>
<td>Set</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.30</td>
<td>11 KV H.G. Fuse (Set for 3 phases) with supporting structures</td>
<td>Set</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Control Room Equipments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.01</td>
<td>Control &amp; Relay Panel for 220 KV feeder Type- SAS-FCB/FRB</td>
<td>Nos</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.02</td>
<td>Control &amp; Relay Panel for 220 KV Transformer (220 KV side) Type-SAS-THCB/THRB</td>
<td>Nos</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.03</td>
<td>Control &amp; Relay Panel for 220 KV Bus Coupler Type- SAS-BCCB &amp; BCRB</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.04</td>
<td>Control &amp; Relay Panel for 220 KV Transfer Bus Coupler Type- SAS-BTCB &amp; BTRB</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.05</td>
<td>220 kV Bus bar Protection Scheme Type- SAS-BBBB</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.06</td>
<td>Control &amp; Relay Panel for 25 MVAR Reactor (220 kV Side) Type- SAS-RCB &amp; RRB</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.07</td>
<td>Substation Automation Network Panel Type-SAS-NW</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.08</td>
<td>Substation Network Panel Type-SAS-FN</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.09</td>
<td>Time Synchronization and Gateway Panel, Type-SAS-TSE/GW</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.10</td>
<td>Sub-station Auxiliary Monitoring Panel, Type- SAS-SAMP</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.11</td>
<td>Control &amp; Relay Panel for 33 KV Transformer incomer + Bus Coupler Panel (combined for incomer + Bus Coupler), Type- SAS-FCRD</td>
<td>Nos</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.12</td>
<td>Control &amp; Relay Panel for 33 KV Feeders/Sectioniser Type-SAS-FCRD (each panel comprises two feeders)</td>
<td>Nos</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>3.13</td>
<td>Battery Set 220 Volts, 400 AH</td>
<td>Nos</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.14</td>
<td>Battery Charger 220 Volts, 400 AH</td>
<td>Nos</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.15</td>
<td>220 Volts DC Distribution Board (With 2 Nos. I/C &amp; auto change over facility)</td>
<td>Nos</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.16</td>
<td>L. T. Panel 800A (2 I/C 800A, 1 B/C, 2 O/G 400A, 6 O/G 32A (having facility of interconnection with ACDB Panel)</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.17</td>
<td>Lighting Distribution Board</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.18</td>
<td>Outdoor AC Distribution Box:(i) For 220kV Bays: 1 I/C 100A &amp; 12 O/G 16A</td>
<td>Nos</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3.19</td>
<td>Outdoor AC Distribution Box:(ii) For 33kV Bays: 2 I/C 100A &amp; 24 O/G 16A</td>
<td>Nos</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### 4. Bus Bar Material

<p>| 4.01 | Single Tension Hardware for AL-59 Eq. wt. Zebra (Bolted type) | Lot | 1 | 1 | 1 | 1 | Lot |
| 4.02 | Single/ Double Tension Hardware for Double AL-59 Eq.wt Zebra (Bolted type) | Lot | 1 | 1 | 1 | 1 | Lot |
| 4.03 | Single/ Double Suspension Hardware for Double AL 59 Eqwt Zebra | Lot | 1 | 1 | 1 | 1 | Lot |
| 4.04 | Single/ Double Tension Hardware for Twin Tarantulla | Lot | 1 | 1 | 1 | 1 | Lot |</p>
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Lot</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.05</td>
<td>Single/ Double Suspension Hardware for Twin Tarantulla</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.06</td>
<td>Disc Insulators, 120 KN</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.07</td>
<td>Disc Insulators, 70 / 90 KN</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.08</td>
<td>AL-59 Conductor (Moose equivalent)</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.09</td>
<td>AAC Tarantula conductor</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.10</td>
<td>ACSR Panther Conductor for jumper of 33 kv PT only</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.11</td>
<td>Earthwire, 7 / 3.15 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.12</td>
<td>Earthwire Tension Hardware, 7 / 3.15 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.13</td>
<td>Clamps &amp; Connectors i.e. PG-clamps, T-clamps, PI clamps, Bus bar spacers etc and terminal connectors for Equipments for AL-59 (Moose equivalent and weight equivalent to Zebra) conductor as per specification requirements.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.14</td>
<td>Clamps &amp; Connectors i.e. PG-clamps, T-clamps, PI clamps, Bus bar spacers etc and terminal connectors for Equipments for AAC Tarantula conductor as per specification requirements. (PANTHER for jumper of 33 kv PT only.)</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>4.15</td>
<td>Clamps &amp; Connectors i.e. PG-clamps, T-clamps etc for Earthwire as per specification requirements.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>5.01</td>
<td>Copper Control Cables of assorted size</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>6</td>
<td>LT Power Cable (Aluminium)</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
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<tr>
<td>6.01</td>
<td>3½ core x 300 sq. mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>6.02</td>
<td>3½ core x 35 sq. mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7</td>
<td>Earthing Material</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.01</td>
<td>M. S. Round 40 mm. dia.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.02</td>
<td>M. S. Flat 75x12mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.03</td>
<td>M. S. Flat 50 x 12 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.04</td>
<td>M. S. Flat 50 x 8 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.05</td>
<td>M. S. Flat 50 x 6 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>7.06</td>
<td>M.S. Pipe electrode 40mm</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>8</td>
<td>Others</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>8.01</td>
<td>GI Channel 100 x 50 x 6 mm.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>8.02</td>
<td>Chequered plates for Control Room</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>8.03</td>
<td>ISI marked insulating mats for electrical purpose (Rubber mating of size 05m x 01m x 3mm)</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>9</td>
<td>Lighting/ Illumination (LED Lighting)</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>9.01</td>
<td>In Switchyard Area</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>9.02</td>
<td>Street light from main Gate upto Control Room &amp; upto switchyard Gate.</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td>10</td>
<td>Fire Fighting Equipments</td>
<td>Lot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Lot</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Nos</td>
<td></td>
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<tr>
<td>---</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10.01</td>
<td>ISI Marked trolley mounted Fire Extinguishers mechanical foam type 9 litres as per specification.</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.02</td>
<td>ISI Marked trolley mounted Fire Extinguishers dry powder (Cartridge type) 6 kgs. as per specification.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10.03</td>
<td>ISI Marked trolley mounted Fire Extinguishers dry powder (cartridge type) 9 kgs. as per specification.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.04</td>
<td>ISI Marked trolley mounted Fire Extinguishers CO2 type 9 kgs. as per specification.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.05</td>
<td>ISI Marked trolley mounted Fire Extinguishers CO2 type 4.5 kgs. as per specification.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.06</td>
<td>ISI Marked Fire buckets along with stands (each stand suitable for 6 buckets) as per specification.</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td><strong>PLCC Equipment with associated equipments &amp; accessories</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.01</td>
<td>Phase to Phase Coupling Devices (each set consisting of LMU+LMDU).</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11.02</td>
<td>HF Coaxial cable having 75 Ohms unbalanced impedance.</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.03</td>
<td>Digital Signal processor based 40W SSB single Channel Carrier Set (PLCC Panel) suitable for transmitting Data and super imposed channels alongwith fully functional Remote subscriber facility and emergency calling set. (With protection coupler)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.04</td>
<td>Digital Signal processor based 40W SSB single Channel Carrier Set (PLCC Panel) suitable for transmitting Data and super imposed channels alongwith fully functional Remote subscriber facility and emergency calling set. (Without protection coupler)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.05</td>
<td>48V, 50/100 Amp, SMPS based battery charger with N+1 configuration suitable for VRLA maintenance free batteries</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.06</td>
<td>48V 360/600 AH maintenance Free Battery set alongwith accessories and stand.</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.07</td>
<td>48 V DCDB</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.08</td>
<td>Wave traps 0.5mh/1600A with tuning unit, Protection device, terminals clamps, bird barriers etc.(Pedestal type)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 12 FOTE/OFC equipments
| 12.01 | Fully wired cabinet with base 19" equipment rack (including front cover, cable, tray common cards) with fan and control, synchronization, alarm dual power supply input cables | Set | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.02 | Central Processing Unit CPU (CESM) | Nos | 2 | 2 | 2 | 2 | 2 | 10 |
| 12.03 | Power supply unit 48 V DC 85W | Nos | 2 | 2 | 2 | 2 | 2 | 10 |
| 12.04 | OLTE-4 port STM-1(155MBPS) along with SFP U1.2 | Nos | 2 | 2 | 2 | 2 | 8 | 16 |
| 12.05 | OFC patch cord (set of 48 NOS.) | Set | 1 | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.06 | 8 Port 2W/4W E&M Interface cards | Nos | 1 | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.07 | 4 Port Data Interface Card (Programmable) | Nos | 2 | 2 | 2 | 2 | 4 | 12 |
| 12.08 | Ethernet Over SDH transport Caed with four 10/100 base FX and one 1000 Base LX/SX front Interface | Nos | 1 | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.09 | 4 Command Integrated Tele protection card | Nos | 2 | 2 | 2 | 2 | 2 | 8 | 16 |
| 12.10 | Engineering Order wire Phone | Nos | 1 | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.11 | Control Cable 1.5 Sq mm 16 core | Lot | 1 | 1 | 1 | 1 | 1 | 2 | 6 |
| 12.12 | Serial to FO Converter item 9 pin FO cable for connection of SAS to FOTE beyond 10mt. Length both ends of FOTE & SAS | Lot | 1 | 1 | 1 | 1 | 1 | Lot |
| 12.13 | Telephone cable 10 pair unarounded | Lot | 1 | 1 | 1 | 1 | 1 | Lot |
| 13 | Construction of Control Room Building, Rest Rooms, Store Building, Guard Hut, Vehicle parking, GLR, Water harvesting system, Front Lawn, Structure/Equipment Foundation, Iron Gates, Water Cooler with RO, ACs, Fans, Lighting and Furniture, Boundary wall, fencing, Yard & other Roads, Trenches, Land scapping, anti weed treatment etc. | Lot | 1 | 1 | 1 | 1 | 1 | Lot |

Note:-
(i) The item wise quantity appearing in the above table is tentative and may vary to any extent as per site requirement.

(ii) Bidder shall supply 5% of erected quantities of Clamps & Connectors appearing at S. No. 4.13 to 4.15 above as spare. Any fraction will mean the next higher integer number.

(iii) Any other material, equipment & item required to complete the work of Pooling substation & it’s satisfactory operation as per specifications and not included in the above bill of material will be deemed to be included in the total price quoted by the bidder and no extra payment shall be considered by the owner for such additional material, items & equipments.
**LIST OF APPROVED VENDORS AS PER RVPN FOR MAJOR SUB-STATION EQUIPMENTS**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEM</th>
<th>NAME OF APPROVED VENDOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Power transformers:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) M/s Bharat Bijlee Limited, New Delhi.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) M/s Bharat Heavy Electricals Ltd., Jaipur.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) M/s ECE Limited, Sonepath.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d) M/s Transformers &amp; Electricals Kerala Ltd., Kerala.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e) M/s Marsons Limited, Kolkata.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>f) M/s Transformers &amp; Rectifiers (India) Limited, Changodar.</td>
<td></td>
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<tr>
<td></td>
<td>g) M/s EMCO Limited, Thane.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>h) M/s Technical Associates Limited, Lucknow.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) M/s Accurate transformers Limited, Greater Noida(UP).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>j) M/s Indo Tech Transformers Limited, Kanchipuram.</td>
<td></td>
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<tr>
<td></td>
<td>k) M/s Kanohar Electrical Limited, Meerut (UP).</td>
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<tr>
<td></td>
<td>l) M/s Victory Electricals, Channai.</td>
<td></td>
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<tr>
<td></td>
<td>m) M/s Voltamp Transformers Limited, Makarpura, Vadodara.</td>
<td></td>
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<tr>
<td></td>
<td>n) M/s Ashok Transformers Pvt. Ltd, Surat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o) M/s IMP Power Limited, Mumbai.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Conductors:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(A) AL-59 (Moose equivalent) conductor:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) M/s Smita (b) M/s Sharavathy (c) M/s Sterlite (d) M/s Apar (e) M/s Omega Cables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(f) M/s Cabcon.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(B) ACSR Zebra &amp; Panther conductors:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) M/s Agarwal General Engineering Works (Pvt.) Ltd., Jaipur.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) M/s Anamika Conductors LTD, Jaipur</td>
<td></td>
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<tr>
<td></td>
<td>c) M/s Venkateshwara Wires Pvt. Ltd., Jaipur</td>
<td></td>
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<td></td>
<td>d) M/s Oswal Cables Pvt. LTD., Jaipur</td>
<td></td>
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<tr>
<td></td>
<td>e) M/s Prem Cables (Pvt.) Ltd., Pipalia Kalan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>f) M/s Rajasthan Cables &amp; Conductors Pvt. Ltd., Jaipur</td>
<td></td>
</tr>
<tr>
<td></td>
<td>g) M/s Rajasthan Transmission Wires Pvt. Ltd. Jaipur</td>
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<tr>
<td></td>
<td>h) M/s Swastika Conductors, Jaipur.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C) Tarantulla Conductor: M/s Prem Cables, M/s Pipiliyalan, M/s Rajasthan Cables &amp; Conductors, Jaipur.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Circuit Breakers (220 KV, 132KV &amp; 33 KV): ABB/Siemens/Areva/Crompton/BHEL</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>GSS Earth-wire (7/3.15 mm/ 7/4.00 mm):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) M/s Usha Martin, Ranchi.</td>
<td></td>
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<tr>
<td></td>
<td>(b) M/s UIC Udyog Ltd., Kolkata.</td>
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<tr>
<td></td>
<td>(c) M/s Ratlam Wires, Ratlam.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) M/s Ramsarup Industrial Corporation, Kolkata.</td>
<td></td>
</tr>
</tbody>
</table>
5. Isolators:
   (a) 220kV & 132kV: UNIVERSAL/HIVELM/ELEKTROLITE/ALLIED/EXCELL/ELPRO/GR POWER/S&S/SIEMENS/ABB/CROMPTON/AREVA/FARADAY
   (b) 33 KV: UNIVERSAL/HIVELM/ELEKTROLITE/ALLIED/EXCELL/ELPRO/GR POWER/S&S/SIEMENS/ABB/CROMPTON/FARADAY

6. Current transformers (Live tank type):
   (a) 220 KV: ABB/TELK/BHEL/AREVA/CROMPTON/SCT/MEHRU/HEPTACARE
   (b) 132 KV: ABB/TELK/BHEL/AREVA/CROMPTON/SCT/MEHRU/HEPTACARE
   (c) 33 KV PT: KAPCO/MEHRU/ABB/CROMPTON/BHEL/AREVA/HEPTACARE

7. (a) 220 KV CVT: ABB/CROMPTON/BHEL/AREVA.
   (b) 132 KV CVT: ABB/CROMPTON/BHEL/AREVA.
   (c) 33 KV PT: KAPCO/MEHRU/ABB/CROMPTON/BHEL/AREVA/HEPTACARE.

8. Lightning Arrestors:
   (a) 220 KV: OBLUM/LAMCO/AREVA/ELPRO/CROMPTON/ADITYA BIRLA INSULATORS.
   (b) 132 KV: OBLUM/LAMCO/AREVA/ELPRO/CROMPTON/ADITYA BIRLA INSULATORS.
   (c) 33 KV: OBLUM/LAMCO/AREVA/ELPRO/CROMPTON/ADITYA BIRLA INSULATORS.

9. Battery Sets: HBL POWER/AMARA RAJA/EXIDE/AMCO/UBMEC.

10. Substation automation system: ABB/SIEMENS/AREVA

11. Relays: ABB/SIEMENS/AREVA/GE


13. Insulators:
   (a) Disc type: ADITYA BIRLA INSULATOR/BHEL/WSI
   (b) Bus-Post: ADITYA BIRLA INSULATOR/MODERN/BHEL/WSI


15. Exhaust Fans: AREVA/CROMPTON/KHAITAN.

16. Ceiling fans: USHA/CROMPTON/KHAITAN/ORIENT/BAJAJ.

17. Lighting Fixtures: PHILIPS/GEC/BAJAJ/CGL/WIPRO.

18. PLCC EQUIPMENTS:
   (a) HF CABLE: RUCHIKA CABLES/ELECTRONIC CORP./DELTON/TECHNO CABLE.
   (b) BATTERY SET: AMAR RAJA POWER SYSTEM/HBL POWER.
   (c) BATTERY CHARGERS (SMPS): PUNJAB COMM./AMAR RAJA/S M Creative.
   (d) PLCC TERMINAL: ABB/PUNJAB COMMUNICATION/SIEMENS/AREVA.
   (e) WAVE TRAP: AREVA/BPL.
   (f) COUPLING DEVICES: ABB/BPL/SIEMENS/AREVA.
   (g) TELEPHONE INSTRUMENT: BPL/BEETEL/CROMPTON/ITI.
19. Communication Equipments:

(a) Optical Line Terminal Equipment: ABB/SIEMENS/AREVA/NOKIA/ALCATEL
and associated multiplexer equipment,
digital cross connect and Network
Management system

(b) OPGW/OFC/OFAC & Hardware Fittings:

(a) M/s Pirrelli, Italy/U.K./Spain/
(b) M/s Nexans, France/Spain/Germany/
(c) M/s NKT, Finland/Halland/
(d) M/s LG, Korea/M/s.Taihan,Korea
(e) M/s Sumitomo, Japan/
(f) M/s Hitachi Cables, Japan /
(g) M/s Furukawa, Japan/
(h) M/s Fujicura, Japan

(c) Time Synchronizing Equipment (GPS): Meinberg/Arbiter/Hathaway

(d) FOTE: M/s ABB, M/s AREVA & M/s SIEMENS

20. (a) Computer System (Industrial Grade Components):
  Industrial Computer/Server: Chino-Laxon/Dynalog/Advantec/Eq.
  Workstations: IBM/HP/DELL/HCL/WIPRO

(b) Printers:

  (i) Laser: HP/Epson
  (ii) Dot Matrix: Wep/Lipi/TVSE
  (c) Ethernet Switches: Ruggedcom/On-time/Garretcom
  (d) Fiber Optic Cable: Finolex/D-Link/Dax/Linksys/Aksh

21. Laptop/Notebook: HP/IBM/TOSHIBA/DELL

22. Rear Projection LVS system: Barco/Delta/Eq.

23. Fire Fighting system: MEHTA/VIJAY/STEELAGE/TECHNO FAB/UNITECH/ZENITH/
    SUPREME/Mather & PLATT

**NOTE:** The above material & equipments shall be supplied by the contractor from the vendors
as specified in the above vendors list only.
LIST OF ITEMS WHICH SHALL BE SUPPLIED BY THE CONTRACTOR FROM THE MAKES/VENDORS INDICATED AGAINST THEM

<table>
<thead>
<tr>
<th>S. No.</th>
<th>ITEM</th>
<th>NAME OF APPROVED VENDOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC Distribution Board:</td>
<td>MANGAL/SELMOR/OMEGA/DANISH/L&amp;T/CALDYNE/ECS/CONTROL ECE/CONTROL &amp; SWITCHGEAR/SARVANA, BANGLORE/SCHNIDER ELECTRIC, NASIK/VIDYUT CONTROL, GHAZIABAD/BOSE CORPRN., KOLKATA/MAKTEL, VADODARA/UNILEC, GURGAON.</td>
</tr>
<tr>
<td>2</td>
<td>Battery charger: (220/110V)</td>
<td>MANGAL/CHABBI/AMCO/DANISH/AMARA RAJA/CALDYNE/OMEGA /OMEGA/RADITRON HBL POWER/ STATCON/ EXIDE</td>
</tr>
<tr>
<td>3</td>
<td>LT switchgear panel:</td>
<td>SELMOR/DANISH/MANGAL/CHABBI/CALDYNE/L&amp;T/ ECS CONTROL &amp; SWITCHGEAR/SARVANA, BANGLORE/ S</td>
</tr>
<tr>
<td>(a)</td>
<td>Gantry:</td>
<td>---------DO---------</td>
</tr>
<tr>
<td>(b)</td>
<td>Equipment support:</td>
<td>---------DO---------</td>
</tr>
<tr>
<td>5</td>
<td>Control Cables</td>
<td>ASHOKA INDUSTRIES/ROMESH/PLAZA/LAXMI POWER CABLE/</td>
</tr>
<tr>
<td>6</td>
<td>Power Cable</td>
<td>TIRUPATI/RUCHIKA/MAHARAJA/CCI/FORT GLOSTER/FINOLEX/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HAVELLS/INDIAN ALUMINIUM CABLES/ UNIVERSAL CABLES/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INCAB/ ASIAN CABLE/ KEI/ POLYCAB/ TORRENT/NICCO/RPG/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALPHA</td>
</tr>
<tr>
<td>7</td>
<td>Marshalling Kiosk:</td>
<td>MANGAL/SELMOR/DANISH/ECS/SARVANA/BHEL.</td>
</tr>
</tbody>
</table>

NOTE: The above material & equipments shall be supplied by the contractor from the vendors as specified in the above vendors list. However, for above item, in case the bidder opts for some other vendor then such vendor should fulfill following minimum qualifying criteria:-

“The manufacturer should have manufactured, tested and supplied at least the quantity marked against each item as listed below in any one year (i.e. continuous period of 12 months) during last 5 years immediately preceding the bid opening and 50% of the quantity (as per table given below) should have been in satisfactory operation for a period of 3 years immediately preceding the date of opening of technical bid. No performance is required in the case of structures and marshalling kiosks. In order to establish compliance of above criteria, the bidder shall furnish
original C.A. Certificate for meeting supply criteria. The C.A. Certificate should also have Membership No. and address of the Chartered Accountant issuing such certificate. For meeting the performance criteria, the bidder shall furnish the original performance certificate or attested copy of certificate from the user for satisfactory performance. The bidder shall also furnish type test reports as per relevant standard. Equipment wise details of type tests are available in the specification Volume-II. The type test reports should not be older than 7 years on the date of bid opening for which the date of conducting the test will be considered”.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D.C. Distribution Board, 220 V DC</td>
<td>4 Nos.</td>
</tr>
<tr>
<td>2</td>
<td>Battery charger 400AH, 220V</td>
<td>4 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>L.T. Panel, 800A</td>
<td>4 Nos.</td>
</tr>
<tr>
<td>4</td>
<td>Control cables</td>
<td>40 Kms (Assorted size)</td>
</tr>
<tr>
<td>5</td>
<td>LT Power cable: 3.5 x 300 Sq.mm</td>
<td>4 Kms.</td>
</tr>
<tr>
<td>6</td>
<td>Marshalling kiosk</td>
<td>20 Nos. of 220 KV or 132 KV bays.</td>
</tr>
<tr>
<td>7</td>
<td>Sub-station structures</td>
<td>200 MT.</td>
</tr>
</tbody>
</table>

The required documents for approval of the alternate makes will have to be furnished by the bidder and the RSDCL at its option may approve other vendor(s) subject to fulfilling of above requirement, otherwise, the contractor will have to supply the material/ equipment(s) from the vendors listed above.
SECTION-II

TECHNICAL SPECIFICATION FOR 220 & 33 kV CONTROL & PROTECTION PANELS

1.0 **SCOPE:**

1.1 The overall scope of work proposed to be assigned on complete responsibility basis to the successful bidder according to this specification covers the following aspects:

1.1.1 The design, manufacture, testing at manufacturer's works, supply, mounting and complete wiring up of all the equipments as detailed in the equipment schedule of Bay Protection & Control units/panels and associated interface works with substation Automation System, FOR destination supply thereof and testing and commissioning at site.

1.1.2 Erection, Testing and Commissioning (ETC) at site of Protection System panels, Bay Control units, substation Automation System and associated co-ordination works.

1.1.3 Preparation and furnishing of all the required drawings including schematic wiring, internal wiring, external cable connection drawings and co-ordination with existing scheme/s where needed, alongwith PVC re-producible of all drawings.

1.1.4 Preparation and furnishing of co-ordinated control and protection cable schedule for complete control, protection & SAS system.

2.0 **SCHEDULE OF REQUIREMENT:**

The requirement of Control and Protection Panels and their types are mentioned as below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars of Panel/Item</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Panel for 220 kV Transformer (220 kV Side)</td>
<td>SAS-THCB</td>
</tr>
<tr>
<td>2</td>
<td>Relay Panel for 220 kV Transformer (for HV )</td>
<td>SAS-THRIB</td>
</tr>
<tr>
<td>3</td>
<td>Control Panel for 220 kV Feeder</td>
<td>SAS-FCB</td>
</tr>
<tr>
<td>4</td>
<td>Relay Panel for 220 kV Feeder</td>
<td>SAS-FRB</td>
</tr>
<tr>
<td>5</td>
<td>Control Panel for 220 kV Bus Coupler/BCT</td>
<td>SAS-BCCB/SAS-BTCB</td>
</tr>
<tr>
<td>6</td>
<td>Relay Panel for 220 kV Bus Coupler/BCT</td>
<td>SAS-BCRB/SAS-BTRB</td>
</tr>
<tr>
<td>7</td>
<td>220 kV Busbar Protection Relay Panel</td>
<td>SAS-BBRB</td>
</tr>
<tr>
<td>8</td>
<td>Control Panel for 25 MVR reactor (220 kV Side)</td>
<td>SAS-RCB</td>
</tr>
<tr>
<td>9</td>
<td>Relay Panel for 25 MVR Reactor</td>
<td>SAS-RRB</td>
</tr>
<tr>
<td>10</td>
<td>Control and Protection Panel for 33 kV Feeder (I/C 100MVA TRF, O/G)/Bus-coupler [For TWIN FEEDER/BAY]</td>
<td>SAS-FCRD</td>
</tr>
<tr>
<td>11</td>
<td>Substation Automation Network Panel</td>
<td>SAS-NW</td>
</tr>
<tr>
<td>12</td>
<td>Substation Network Panel</td>
<td>SAS-FN</td>
</tr>
<tr>
<td>13</td>
<td>Time Synchronization and Gateway Panel</td>
<td>SAS-TSE/GW</td>
</tr>
</tbody>
</table>
The quantities of panels for substations are indicated elsewhere in the specification.

3.0 SERVICE CONDITIONS:

3.1 CLIMATIC CONDITIONS: As referred above.

4.0 STANDARDS:

Unless otherwise specified elsewhere in this specification, the rating, performance and testing of the equipments supplied, shall conform to the latest revisions, available at the time of placement of order, of all relevant standards listed below.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS-3231</td>
<td>Electrical relays for power system protection.</td>
</tr>
<tr>
<td>2.</td>
<td>IEC-255 Part 1 to 3</td>
<td>Electrical relays for power system protection.</td>
</tr>
<tr>
<td>3.</td>
<td>BS – 142</td>
<td>Electrical relays for power system protection.</td>
</tr>
<tr>
<td>4.</td>
<td>IS – 1248</td>
<td>Indicating instruments.</td>
</tr>
<tr>
<td>5.</td>
<td>IS – 2419</td>
<td>Indicating instruments.</td>
</tr>
<tr>
<td>6.</td>
<td>BS – 89</td>
<td>Recorders</td>
</tr>
<tr>
<td>7.</td>
<td>IS – 6236</td>
<td>Recorders</td>
</tr>
<tr>
<td>8.</td>
<td>IS – 4237</td>
<td>General requirements for switches and control gear for voltages not exceeding 1 kV.</td>
</tr>
<tr>
<td>9.</td>
<td>IS – 375</td>
<td>Marking and arrangements for switch gear, bus bars, main connections and auxiliary wiring.</td>
</tr>
<tr>
<td>10.</td>
<td>BS – 152</td>
<td>Relay coding, auxiliary wiring and panel and wiring.</td>
</tr>
<tr>
<td>11.</td>
<td>IS – 8686</td>
<td>Static protective relays</td>
</tr>
<tr>
<td>12.</td>
<td>IS – 2147</td>
<td>Degree of protection for cubicles</td>
</tr>
<tr>
<td>13.</td>
<td>IEC-297 Part 1-3</td>
<td>Dimensions of mechanical structures of the 482.6mm (19”) series.</td>
</tr>
<tr>
<td>14.</td>
<td>IS – 6875</td>
<td>Control switches (LV Switching devices for control and auxiliary circuits)</td>
</tr>
<tr>
<td>15.</td>
<td>IS – 5</td>
<td>Colour for ready mixed paints and channels.</td>
</tr>
<tr>
<td>16.</td>
<td>IS – 1554</td>
<td>PVC insulated cables up to and including 1000 volts.</td>
</tr>
<tr>
<td></td>
<td>Part-I, 1988</td>
<td>Applications guide for protection</td>
</tr>
<tr>
<td>17.</td>
<td>IS – 3842 Part-II to IV</td>
<td>HRC Cartridge fuse links.</td>
</tr>
<tr>
<td>18.</td>
<td>IS – 9224</td>
<td>Code of practice for phosphating iron and steel</td>
</tr>
<tr>
<td>21.</td>
<td>IS – 11353</td>
<td></td>
</tr>
</tbody>
</table>

25
Characteristics values of input and outputs of single side band PLCC terminals.

Planning of (single side band) power line carrier systems.

Methods of tests for single side band PLC terminals.

Coupling device for PLC systems (note This is to be referred for the PLCC terminal connections.)

Transducers

Fuses

Dry heat test

Electrical heat transient bursts.

PVC Insulated cable for working voltage up to & including 1100 volt.

**List of IEC standards**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Electromagnetic Compatibility type test:</td>
</tr>
<tr>
<td>1.</td>
<td>IEC-60255-22-1, Class-III, IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III</td>
<td>MHz burst disturbance Electrostatic discharge Direct application Indirect application</td>
</tr>
<tr>
<td>2.</td>
<td>IEC-, 60255-22-5</td>
<td>Surge immunity test</td>
</tr>
<tr>
<td>3.</td>
<td>IEC-60255-22-7, Class-A</td>
<td>Fast transient disturbance</td>
</tr>
<tr>
<td>4.</td>
<td>IEC-61000-4-8, Class-V</td>
<td>Power frequency magnetic field test</td>
</tr>
<tr>
<td>5.</td>
<td>IEC-60255-22-3</td>
<td>Radiated electromagnetic field disturbance</td>
</tr>
<tr>
<td>6.</td>
<td>EN-61000-4-3</td>
<td>Radiated electromagnetic field disturbance</td>
</tr>
<tr>
<td>7.</td>
<td>IEEE/ANSI/C37.90.2</td>
<td>Radiated electromagnetic field disturbance</td>
</tr>
<tr>
<td>8.</td>
<td>IEC- 60255-22-3</td>
<td>Conducted electromagnetic field disturbance</td>
</tr>
<tr>
<td>9.</td>
<td>IEC- 60255-25</td>
<td>Radiated emission Insulation tests:</td>
</tr>
<tr>
<td>10.</td>
<td>IEC- 60255-5</td>
<td>Dielectric test Impulse voltage test Insulation resistance</td>
</tr>
</tbody>
</table>

Environmental tests:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IEC-60068-2-1</td>
<td>Cold test Storage test</td>
</tr>
<tr>
<td>2.</td>
<td>IEC-60068-2-2</td>
<td>Dry heat test</td>
</tr>
<tr>
<td>3.</td>
<td>IEC-60068-2-3</td>
<td>Damp heat test, steady state</td>
</tr>
</tbody>
</table>
4. IEC-60068-2-30 Damp heat test, cyclic

CE compliance

1. IEC- 60255-26 Immunity
2. IEC- 60255-26 Emissive Test
3. EN-50178 Low voltage directive

Mechanical tests

1. IEC- 60255-21-1 Vibration
2. IEC- 60255-21-2 Shock and bump
3. IEC- 60255-21-3 Seismic

Communication


5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 The Bidder’s scope of work shall include the design, engineering, supply, delivery, installation, testing and commissioning of the following:

The Substation Automation System (SAS) for the proposed pooling substation including Workstations, MIMIC display, furniture and all other equipment required for the SAS for the proposed substation as defined in this specification.

Bay protection panels, bay control units (BCU) to be located in each bay cubicle, associated cabling, interconnections and integration of these panels.

Laying and integration of Fiber optics cable between all BCUs and bay cubicles and Substation Automation System at Control Room.

5.2 Dedicated Bay Control Units and Bay Protection Units (BPU) shall be provided for each bay for Control and protection functionality on IEC-61850 standard. The offered protection and control unit will comply with the logical node structure as per IEC-61850 and the trip and priority messages viz. interlocking data shall be on GOOSE. Combined Bay Protection and Control Unit shall not be acceptable. The required Control functions in BCU and Protection functions in BPU shall be as per the details given in this specification.

5.3 One Bay Control Unit shall provide complete functionality for one 220 kV and 33 kV bay. Each set of BCUs shall have sufficient digital inputs to acquire the status of each and every circuit breakers, isolator, earth switch etc. covered in that bay. Similarly the digital output shall be sufficient to control all the switchgears in one bay.

5.2 Panel Specifications

5.4.1 All protection panels proposed to be simplex type having overall dimensions 2312mm (Height) x 800mm (Width) x 650mm (Depth). It is the responsibility of the contractor to
ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary provide panels with larger dimensions. No price increase at a later date on this account shall be allowed.

5.4.2 The relay panels shall be modular rack mounting type consisting of standard 19" (483mm) width racks in accordance with the IEC-297. The relays shall be suitable to form composite relay assemblies in 19” racks to form complete protection schemes with minimum external wiring involved. Ancillary components like switches, lamps etc. whatever needed, for protection schemes shall be installed on plates suitable for mounting in 19” racks. The relay panel shall have full transparent (Perspex) front door. The slots for inter panel wiring shall be spaced at 300 mm from top of the side panel and their size shall be 80 mm(H) x 300 mm(W).

5.4.3 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof to meet the requirements to IP 31 of IS 2147.

5.4.4 The panels shall be free standing, floor mounting type and shall comprise rigid, welded structural frame, enclosed completely with specially selected, smooth finished, cold rolled sheet steel of thickness not less than 3mm for front and rear portion and 2.5mm for side top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

5.4.5 All doors and removable covers shall be gasketed all around with neoprene gaskets. Ventilating louvers, if provided, shall have screens and filters.

5.4.6 Design, material selection and workmanship shall be such as to result in neat appearance inside and outside with no weld, rivets or bolt heads apparent from outside and with all exterior surfaces true and smooth.

5.4.7 Panels shall have base frames with smooth bearing surface which shall be fixed on the embedded foundation channels/insert plates. All necessary anchor bolts, Base frames, foundation channels/insert plates, and other materials required for foundation of panels shall be supplied. Anti vibration strip made of shock absorbing materials that shall be supplied by the contractor shall be placed between panel and base frame.

5.4.8 Cable entries to the panel shall be from the bottom. The plates of the panel shall be fitted with removable gland plates for fixing the cable glands. Necessary number of cable glands of sizes to suit different cables getting terminated in the panels shall be supplied by the contractor. Cable glands shall be screwed type, and shall be suitable for PVC cables. Cable gland plate fitted in the bottom of the Panel shall be connected to the earthing Panel/Station through a flexible braided copper conductor rigidly. All the panel shall have LED illuminations.

5.4.9 Relay panels of modern, modular construction would also be acceptable.

5.4.10 The width and depth of panel shall be well designed for giving sufficient room and space for ease of working and safety.

5.5 Label:

5.5.1 All front mounted equipment as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. A label engraved with panel designation shall be provided at the top of each panel.

5.5.2 All the front mounted equipment shall also be provided tag numbers corresponding to the ones shown in the panel internal wiring to facilitate easy tracing of the wiring. These labels
shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

5.5.3 Labels shall be made of 0.5 mm Matte finish metal photo material printed photographically using the Metal photo process with images sealed below the anodic layer. Labels shall have silver letters on black background.

5.5.4 All equipments mounted inside the panels shall be individually identified using PVC labels.

5.6 **Internal Wiring and other Accessory Equipment:**

a) Panels shall be supplied completely with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally. These adjacent inter panel wiring shall be clearly indicated in the drawing furnished by the contractor.

b) All wiring shall be carried out with 1100 V grade, single core, stranded copper conductor wires with PVC insulation and shall be heat resistant grade and vermin and rodent proof. The minimum size of the stranded copper conductor used for internal wiring shall be as follows:
   i) All circuits except current transformer circuits one multi strand 1.5 sq.mm per lead
   ii) Current transformer circuit: one 2.5 sq.mm per lead. The minimum number of strands per conductor shall be three.
   iii) Voltage transformer circuits (for energy meters) two of 2.5 sq.mm per lead.

c) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

d) Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

e) Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.

f) All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Numbers 6 and 9 shall not be included for ferrule purposes.

g) Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Interconnections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots or holes meant for taking the inter-connecting wires. Arrangements shall permit easy inter connections to adjacent panels at site and wires for this purposes shall be provided by Contractor looped and bunched properly inside the panel.

h) Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

i) For Inter panel wiring, terminations shall be done on bottom side of panel.

j) The indicating lamp shall be of LED type with sufficient brightness. Coloured LED lamps shall be used for appropriate indication.

5.7 **Miscellaneous Accessories:**
a) Plug point-A AC 240 Volts, single phase, 50 HZ AC socket shall be provided in the interior of each cubicle with "ON-OFF" Switch for connection of hand lamps.

b) Interior lighting: Each panel shall be provided with a fluorescent lighting fixture rated for 240 volts, single phase, 50 HZ supply for the interior illumination of the panel during maintenance. The fittings shall be complete with switch fuse unit and switching of the lighting shall be controlled by the respective panel door switch.

c) Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control signaling, lighting and space heater circuits. MCBs for the incoming circuits and fuses for sub-circuits shall be provided. Selection of the main and sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS:13947. Each MCB shall be provided with a potential free contact and the same shall be wired for annunciation purpose. Potential circuit for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS:2208 / 13703 mounted on plug-in type fuse bases. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

d) Space heater: Each panel shall be provided with a space heater rated for 240 V, single phase, 50 Hz AC for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with isolating switching HRC fuse on phase and link on the neutral of the heater supply and its switching shall be controlled by a thermostat.

e) Other Accessories

Test link, special terminal boards and other accessories normally required for testing operation and maintenance of all relays and meters shall be furnished by the tenderer.

5.8 Earthing:

a) All panels shall be equipped with an earth bus securely screwed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be atleast 25 x 6 mm copper flat. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

b) Provision shall be made on each earth bus bars of the end panels for connection to main earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of contractor. The wire or screens should be clearly bonded and earthed at the gland plate.

c) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus preferably by independent copper wires of size not less than 2.5 sq.mm. The colour code of earthing wires shall be green. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted.

d) Looping of earth connections which would result in loss of earth connection to other devices where the loop is broken shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

e) VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that
earthing may be removed from one group without disturbing continuity of earthing system for other groups.

f) Detailed earthing scheme shall be submitted for approval.

5.9 **Indicating Lamps/ LEDs:**

5.9.1 Indicating lamps shall be panel mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, un-breakable and moulded from heat resisting material. The lamps shall be of LED type. The supply for LED shall be from DC station batteries, unless stated otherwise, at 220V.

5.9.2 The wattage and resistance of the lamps shall be as follows:
   i) 220/250 V – 5 to 10 W – 4000 to 8000 Ohms
   ii) 110 V – 5 to 10 W – 1000 to 2000 Ohms

5.9.3 Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

5.9.4 The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

5.9.5 LED shall be furnished 20% in excess of actual numbers required and caps shall be furnished 10% in excess of actual numbers used for each colour. The corresponding breaker position of indicating lamps shall flash for condition of discrepancy between the last operation of circuit breaker (ON and OFF) and become steady when the switch is operated to correspond with the position of the circuit breaker. The discrepancy signal when the breaker is tripped shall also be followed by the sound signal.

5.10 **Terminal Blocks:**

a) All internal wiring to be connected to the external equipment shall terminate on terminal blocks preferably vertically mounted on the side of each panel. Terminal blocks shall be 1100V grade and have 10 amps continuous rating moulded piece complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fiber markings strip with clear plastic slip-on/clip-on terminal covers. Markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.

b) Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

c) At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

d) Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductor cable on each side:
   i) All circuits except current transformer circuits: minimum of one of 2.5 sq.mm copper
   ii) All CT circuits: minimum of two of 2.5 mm square copper and all PT circuits minimum of two of 2.5 sq.mm copper.
   iii) AC / DC power supply circuits.- 1No. of 6 sq. mm Alluminium
e) There shall be a minimum clearance of 250 mm between the first row of terminal blocks and associated cable gland plate. Also the clearance between two rows of terminal blocks shall be minimum, of 150 mm.

f) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run parallel and in close proximity along each side of wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for NIGAM's external cable connection. An adjacent terminal block shall also share this field wiring corridor. A steel strip shall be connected between adjacent terminal block rows at 450 mm intervals for support of incoming cables.

g) All necessary cable terminating accessories such as gland plates, packing glanders, crimp type tinned copper lugs supporting clamps and brackets, wiring troughs and gutters etc., shall be included in contractor's scope of supply.

5.12 **Push Buttons:**

5.12.1 Push button shall be momentary contact type with rear Terminal connections. Where required, the push button shall be suitably shrouded to prevent inadvertent operation. It shall be provided with integral inscription plate engraved with its function.

5.12.2 All push buttons shall have two normally open and two normally closed contacts. The contact faces shall be silver-plated. The contacts shall be able to make/break and carry appropriate currents for the functions desired.

5.13 **Painting:**

5.13.1 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of practice for Phosphating Iron and Steel".

5.13.2 Oil, grease, dirt etc. shall be thoroughly removed by emulsion cleaning.

5.13.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

5.13.4 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and oven drying.

5.13.5 The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "Flash dried" while the second coat shall be stoved.

5.13.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The panel shall have colour conforming to shade 631 of IS-5 for outside and white colour inside of the panel with black colour for base frame.

5.13.7 Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.

5.13.8 Finished painted appearance of panel shall present an aesthetically pleasing appearance free from dents and uneven surface.

5.13.9 A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panel.

5.13.10 The bidder may follow any other established painting procedure like electro-static painting etc.
5.14 **Mounting:**

a) All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connection. The equipment on front of panel shall be mounted flush.

b) Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking shall be clearly visible.

c) The center lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The center lines of relays, meters and recorders shall be not less than 450 mm from the bottom of the panel. Cutouts, if any, provided for future mounting of equipment shall be properly blanked off with blanking plates.

d) The center lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top lines of all meters, relays and recorders etc., shall be matched.

e) No equipment shall be mounted on the doors.

f) All the equipment connections and cabling shall be designed and arranged to minimize the risk of fire and damage which may be caused by fire.

6.0 **GENERAL SPECIFICATION FOR BAY CONTROL UNIT (BCU):**

6.1 The bay control IED based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions such as protection commands, bay interlocking, data acquisition, data storage, event and disturbance recording and shall provide inputs and status indication and outputs for commands. They shall be directly connected to the switchgear without any need for separate interposing equipment or transducers.

6.2 The numerical bay control IED shall be provided with a configurable (current or voltage) analogue input channels and adequate number of binary input and output channels which are galvanically isolated from the SA system. HV switchgear and instrument transformers shall be directly connected to the bay level IED without any interposing equipment (except test switches/plugs required for testing purposes).

6.3 The devices shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 60255 to conform to the high requirements for operation on the secondary system of HV switchgear.

6.4 The 220 kV & 33 kV bay control & protection IED shall have the following features:

- Configurable analogue channels
- Power functions which can be configured to measure forward or reverse active or reactive power
- Four (4) independently settable parameter setting groups settable/ selectable locally or remotely via the HMI programme.
- The offered IED shall have a comprehensive local MMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.
  - Alphanumeric backlit LCD display unit
o Fixed LEDs for indication of relay in & out of service. Programmable 14 LEDs for trip/alarm conditions.
o Keypad for browsing, setting the relay parameters
➢ Sequence of Event recorder with a buffer for minimum 200 events and a resolution of 1 msec. The events that are to be recorded should be freely programmable. These could be alarm/ trip signals, external signals connected to opto-coupler inputs, internal inputs etc. Once events are defined they are recorded in chronological order as they occur.
➢ Comprehensive self-supervision
➢ Battery-free memory back-up of Events and Disturbance records
➢ Logic functions (AND, OR, bi-stable flip flop etc.)
➢ Delay Integrator function

6.5 The numerical bay control IEDs shall be mounted in cubicles of Protection Class IP54 or better. Back-up control mimics and associated switchgear with all the interlocks shall be provided. This shall also be with two years proven field experience for HV applications. Emergency control facility also to be provided to handle the bay controller fail situations. The distributed back-up control mimic shall be installed alongwith the bay controller IED which can be used in case of maintenance or emergency or if bay control IED fails. Local bay control via the back-up control mimic on the control and protection cubicles shall incorporate the same user safety measures e.g. bay interlocking, synchro-check, user guidance etc. as the station HMI local bay emergency control shall be key-locked and the control either from station HMI or from remote shall be disables if the local/ remote selector witch is in the local position.

6.6 The bay IED shall have atleast two communication ports viz. Front Ethernet RJ45/RS-232 port for local communication for relay settings, modifications, extraction and analysis of fault/event/ disturbance records from a laptop and a Rear fiber optic port on IEC61850 standard for remote communication to SCADA system.

6.7 The electronic system has to be provided with functions for self-supervision and testing. Each circuit board shall contain circuits for automatic testing of its own function.

6.8 Faults in the bay control IED shall be indicated on a front HMI and a message shall be sent to the station level HMI. The time for the fault tracing and the replacement of a faulty unit shall be reduced to a minimum. The supervision shall also cover the power supply system, the internal system bus and the ability of the central processing module to communicate with different printed circuit boards.

6.9 Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown. The n-1 criteria must be maintained in worst case scenario also. Further, a single failure must not have any affect on the primary system, which is monitored and controlled.

6.10 All IEDs shall have two year of successful proven field experience in HV application and MTBF for the offered unit shall be provided.

7.0 GENERAL SPECIFICATION OF BAY PROTECTION UNIT (BPU)

7.1 Each Bay Protection Unit shall comprise one or more numerical relays to meet the protection requirements specified for each type of feeder.

7.2 Bay Protection Units for 220 & 33 kV Switchyard Bays shall interact with BCUs over 220 & 33 kV inter bay Network Bus to share information related to Bay Level Interlocking,
fault data, alarms/events etc. However, the trip commands from Bay Protection Units shall be hard-wired directly to appropriate switchyard equipment. Also, critical interlocking data between Bay Protection Units and Bay Control Units, including the substation level interlocks such as bus earth switch etc. shall also be hard-wired to ensure complete bay level functionality even in case of failure of substation LAN. The interlocking information to be hard-wired between Bay Protection Units and Bay Control Units shall be decided by Owner during detailed engineering stage.

7.3 The Bay Protection Units shall be arranged to provide two independent, high performance and reliable systems with separate DC supplies, separate CT/VT cores, separate cables and trip relays to obtain 100% redundancy. Associated trip relays of the two systems shall be separate, having a sufficient number of contacts for all the functions. The DC Changeover scheme shall be realized externally via the auxiliary AC/DC Relays.

7.4 The offered relays shall be completely numerical with Protection elements realized using software algorithm. Hardware based/Analog measurement shall not be acceptable.

7.5 The relay should have high immunity to electrical and electromagnetic interference. It should be compatible with all the IS/IEC standards as listed above.

7.6 The offered relay shall have a comprehensive local MMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.

- Alphanumeric backlit LCD display unit
- Fixed LEDs for indication of relay in & out of service. Programmable 14 LEDs for trip/alarm conditions.
- Keypad for browsing, setting the relay parameters

7.7 The bay IED shall have atleast two communication ports viz. Front Ethernet RJ45/RS-232 port for local communication for relay settings, modifications, extraction and analysis of fault/event/ disturbance records from a laptop and a Rear fiber optic port on IEC61850 standard for remote communication to SCADA system.

7.8 The relays shall have the following tools for fault diagnostics

- Fault record – The relay shall have the facility to store fault records with information on cause of trip, date, time, trip values of electrical parameters.
- Event record – The relay shall have the facility to store time stamped event records with 1ms resolution.
- Disturbance records – At least 5 secs of disturbance records shall be provided in the offered Numerical relays. Each record shall store data from analogue channels and digital channels. The data from DR function shall be available in IEEE/COMTRADE format and shall be compatible with the relay test kit being supplied under this contract.

7.9 It shall be possible to store this information in the event of an auxiliary supply failure with the help of a battery back up.

7.10 The relay settings shall be provided with password protection.

7.11 It shall be possible to change the relay setting from the front panel using the keypads.

7.12 The relay shall have comprehensive self-diagnostics feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through an output watchdog contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.
7.13 The Numerical Relays shall be provided with 1 set of common support Windows based software which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements. The relay settings shall also be changed from local or remote using the same software.

8.0 VARIOUS ELEMENTS OF PROTECTION SYSTEM/SCHEMES:

THE DETAILS OF AUXILIARY RELAYS, SCHEMES, FUNCTIONS ETC. HAVE BEEN DESCRIBED BELOW. IT SHALL BE THE BIDDERS RESPONSIBILITY TO USE THE SAME FOR THE COMPLETION OF SCHEMES. FEW OF THE FUNCTIONALITIES SUCH AS MEASURING/INDICATING METERS, SEMAPHORES, VOLTAGE & FREQUENCY RECORDING INSTRUMENTS, DISTURBANCE RECORDING, EVENT LOGGING, SYNCHRONIZATION, VOLTAGE SELECTION, ANNUNCIATION, TRIP CIRCUIT SUPERVISION, DC SUPPLY SUPERVISION, SWITCHES ETC. ARE NORMALLY PART OF THE BAY CONTROL/BAY PROTECTION UNITS. THE BIDDER IS REQUIRED TO DESIGN THE SCHEME/SYSTEM SO AS TO MEET THE FUNCTIONAL REQUIREMENTS AND RELIABLE OPERATIONS. THE INTEGRATED FUNCTIONALITIES ARE ACCEPTABLE SUBJECT TO FEW EXCEPTIONS SUCH AS MASTER TRIP RELAYS, AUXILIARY RELAYS, LBB, DC SUPERVISION, REVENUE METERS, TIMERS, EMERGENCY CONTROLS ETC. ARE REQUIRED TO BE PROVIDED/INSTALLED EXTERNAL TO BCU/BPU.

THEREFORE, THE C&R PANELS SHALL BE DESIGNED BY THE BIDDER FOR OPTIMIZED CONFIGURATION AND IF DESIGNATED FUNCTIONALITIES ARE TO BE ACHIEVED USING EXTERNAL DEVICES/EQUIPMENTS THE SAME SHALL BE DEEMED TO BE INCLUDED IN THE COST OF C&R PANELS MENTIONED IN THE PRICE SCHEDULES. IT WILL BE THE BIDDERS RESPONSIBILITY TO ENSURE THE COMPLETENESS OF THE SCHEME.

8.1 Instruments and Meters:

a) All instruments, meters, recorders and transducers shall be enclosed in dust proof, moisture resistant, cases and shall be suitable for tropical use. They shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration, check and adjustment at site. Watt and Var meters shall have an indication of (+) and (-) to indicate EXPORT and IMPORT respectively. Digital voltage and frequency meters shall be of class: 0.5 and shall have digital display of 5 and 4 digits respectively, with display size, not less than 25 mm (height). All accessories including test switches and test plugs, where applicable shall be furnished. Their elements shall be shock resistant and shielded from external magnetic fields.

b) Indicating Instruments: Digital instruments shall have digital display of not less than 25mm (height). Instrument shall have four digit display.

i) Unless otherwise specified all electrical indicating instruments shall be of 96sq. mm size. They shall be suitable for flush mounting.

ii) The dial shall be free from warping, fading and discoloring. The dial shall also be free from parallax error.

iii) Instruments shall conform to IS:1248 and shall have accuracy class of 1.0 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.

iv) Instrument covers shall be of shadow proof design, utilizing all available light. The indicating instruments shall have red marks on the dial corresponding to rated values of the associated primary equipment.
v) Ammeters and current coils of watt meters and VAR meters shall continuously withstand 120% of rated current and 10 times the rated current for 0.5 sec. without loss of accuracy. Voltmeters and potential coils of watt meters and VAR meters shall withstand 120% of rated voltage for 0.5 seconds without loss of accuracy.

c) **Metering Instruments:**

1. **Ammeters:**

   All ammeters shall be of digital type and provided with direct reading triple range scale. Scale value of ammeters shall be equal to 1 to 1.3 times the rated primary current of the current transformer feeding it. The rated current shall be 1.0 Amp. Accurate reading of ammeter shall be possible at the lowest limit of 5% of the rated current.

2. **Voltmeter:**

   Voltmeter shall be digital type. Rated voltage shall be 110/\sqrt[3]{3} Volts. Maximum value of voltage scale shall be 20% in excess of the normal voltage.

3. **Multifunction Meter:**

   i) It shall be able to do measurement for 3-Phase, 4-Wire unbalanced loads.

   ii) It shall be of 0.5 Class accuracy and shall be able to measure following parameters mentioned below,

   - Phase to Phase and Phase to Neutral Voltages
   - Phase Currents
   - Neutral Current
   - Frequency
   - Power Factor
   - Reactive Power
   - Active Power
   - Apparent Power
   - Per Phase: kW, KVAR, KVA, PF
   - Total Harmonic Distortion of Voltage and Currents
   - Import/ Export (MWh, MVArh) & MVAh
   - Max/ Min Voltages, Currents
   - Max MW/ MVA

   iii) **Input Requirements:**

   - **Voltage:**
     - Input: 500 V (P-P) and 280 V (P-N)
     - Burden: <0.15VA
   - **Current:**
     - Range: 1A or 5A
     - Continuous: 1A CT: 3A
       - 5A CT: 12A
     - Surge with-stand: 1A CT: 80A for 1 Sec.
       - 5A CT: 200A for 1 Sec.
iv) The device shall be able to accommodate the ratios of installed CT/PT (as shown in the single diagrams enclosed with these specifications) and have adequate reading range for the substations under consideration.

v) The device shall have the communication port RS-232/RS-485 having Modbus Protocol or any other open protocol.

vi) Power Supply: AC/DC 110-230V


8.2 Relays:

a) All relays shall conform to the requirements of IS: 3231/IEC-60255/IEC-61000 or other applicable approved standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear.

b) All main protective relays (distance, differential, Back-up etc.) shall be of numerical type and communication protocol shall be as per IEC-61850. Further, the test levels of EMI as indicated in IEC-61850 shall be applicable to these. All the relays shall be directly connected to the inter bay bus using fiber optic cables and shall support peer to peer communication. The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays. Each relay should also generate an ICD file in XML format for engineering/ integration to a vendor independent SCADA system.

c) All protective relays shall be in draw out or plug-in type/ modular cases with proper testing facilities. The testing facilities provided on the relays shall be specifically stated in the bid. Necessary test plugs shall be supplied loose and shall be included in Contractor's scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to test block and test plug arrangements the Contractor shall also quote alternative testing facility of protective relays by providing a push button which when pressed connects the testing equipment to the relay coils and injects current in the coil and automatically disconnects the trip circuits and on operation of relay gives a signal that the equipment and the circuits are correct. The above tests shall be carried out without short circuiting the CT secondary connections. The NIGAM reserves the right for accepting any one of the above two testing facilities. Unless otherwise specified all auxiliary relays and timers shall be supplied in non-draw out cases/plug in type modular cases.

d) All AC relays shall be suitable for operation at 50Hz AC Voltage operated relays shall be suitable for 110/ √3 volts VT secondaries and current operated relays for 1 Amp CT secondaries as specified in this specification. DC auxiliary relays and timers shall be designed for 220/ 110 V DC voltage and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

e) The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts/suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring of circuits etc.,
and also required for the complete protection schemes described in the specification shall be provided.

All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme. Contacts shall be silver faced with spring action. Relay cases shall have adequate number of terminals for making potential free external connections to the relay coils and contacts including spare contacts. Relay case size shall be so chosen as not to introduce any limitations on the use of available contacts on the relay due to inadequacy of terminals. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

f) All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators, provided with inscription, subject to RSDCL's approval. All protective relays which do not have built in hand reset operation indicators shall have additional auxiliary relays with operating indicators for this purpose. Similar separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Bucholz relays, temperature protection, fire protection etc.

g) Timers shall be of the solid state type. Pneumatic timers are not acceptable. Short time delays in terms of milliseconds may be obtained by using copper slugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not acceptable.

h) No control relay which shall trip the power circuit breaker when the relay is de-energized shall be employed in the circuits. All relays shall be self reset type unless specified otherwise.

i) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

j) All relays shall withstand a test voltage 2.5 kV, 50 HZ, rms voltage for one second. In case of static relays the sub clause ‘m’ of this clause shall be applicable.

k) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

   i) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.

   ii) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.

   iii) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the DC supply voltage is minimum.

   iv) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s), but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, re-closing function etc.), and the alarm output signals.

   v) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set
threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).

vi) For the current seal-in method, the seal-in shall be maintained until the circuit-breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single – and three-pole tripping.

vii) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions) or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).

l) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

m) Wherever solid static relays are used, the following requirements shall be met with:
   i) The printed circuit cards shall be of fiberglass type and the contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit boards shall be encapsulated or covered with varnish.
   ii) The components shall be rated to carry at least twice the normal expected loads. The resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes. The relays must withstand the requirements of IEC 255-4 appendix-E class III regarding HF disturbance tests; IEC 255-4 regarding impulse test at 5 kV and fast transient test as per IEC 801-4. Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous sources do not cause damage to static circuits.
   iii) All relays shall be designed for satisfactory performance under tropical and humid conditions specified elsewhere in the specification. Special mention shall be made in the technical deviations schedule of the bid for those relays, if any, that Contractor proposes to use which differ from specified requirements.
   iv) All devices required for correct operation of each relay shall be provided by Contractor without any extra cost.
   v) The contractor shall ensure that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of relay case size offered shall not create any restrictions on the availability of the contact terminals for wiring connections.
   vi) DC/DC converter shall be provided in the protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation. Provision of DC cells in the protective relays as reliable standby power supply will however not be acceptable.
   vii) The relays shall be stable and suitably protected against transient/induced over voltages and noise signals. The Contractor shall state clearly in his bid special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of relays offered.
   viii) All equipment shall be of modular construction and the modules and sub units shall be of plug in type for easy replacement. The design shall permit fast recognition of defects and facilitate easy repair. Appropriate indication shall be available to enable
speedy internal fault location. AC components shall be readily accessible for easy
disassembly and replacement. Readily accessible and clearly marked test prints shall
be provided at all important points in the circuit. Screw clamp terminals shall be
provided for interconnection with relaying equipment. It shall be possible to test the
protection channels with the equipment fully operational without rendering the
equipment ineffective for genuine signals. Safety equipment such as protection cover
and interlocks shall be provided. Ground terminals with isolating links shall be
provided where required. Numerical relays are acceptable as an alternative to solid
state relays. The following information / confirmation shall also be furnished in the
bid. Numerical relays are provided with built in event / disturbance / fault recorder
features. The bidder shall bring out in the bid that the Numerical relays providing
different protection features / application in a single unit if any one of the application /
feature goes out of service the other feature / application (s) will remain un-effected.

ix) The contractor shall include in his bid a list of installations where the relays quoted
have been in satisfactory operation.

x) The necessary interface software for programming, interacting with the relays shall be
provided free of cost. Necessary software and hardware to up/down load the data
to/from the relay from to the computer installed in the substation shall be provided.

xi) The relay shall have suitable communication facility for connectivity to SAS. The relay
shall be capable of supporting IEC-61850 protocol.

xii) The necessary hardware/ software support shall be given for at least 15 years beyond
warranty at reasonable prices.

8.3  Annunciation System:

a) Alarm annunciation system shall be provided for the control board by means of visual
and audible alarm in order to draw the attention of the operator to the abnormal operating
conditions or the operation of some protective devices. The annunciation equipment shall
be suitable for operation with 220/110 V DC voltage.

b) The visual annunciation shall be provided by annunciation facia, mounted flush on the
top of the panels. The audible alarm shall be provided by alarm buzzer and bell for trip
and non-trip alarm respectively.

c) The annunciator facia shall be provided with translucent plastic window for alarm point
with minimum size of 35 mm x 50 mm. The facia plates shall be engraved in black
lettering with respective inscriptions details of which will be furnished to the Contractor
by the RSDCL.

Alarm inscriptions shall be engraved on each window in not more than three lines and
size of the lettering shall not be less than 5mm.

d) Facia Windows shall be illuminated with LEDs. Each annunciation window shall be
provided with two white lamps in parallel to provide safety against lamp failure. Long
life lamps shall be used. The lamp circuit shall include series resistor of adequate rating.
The cover plate of the facia windows shall be flush with the panel and shall be capable of
easy removal to facilitate replacement of lamps. The transparency of cover plates and
wattage of the lamps provided in the facia windows shall be adequate to ensure clear
visibility of the inscriptions in the control room having high illumination intensity (500
Lux), from the location of the Operator's desk.

e) TRIP AND NONTRIP facia shall be differentiated. All TRIP shall have red colour and
all NONTRIP facia shall have white colour.
The available alarm shall be provided by Buzzer / Hooter / Bell having different sounds and shall be used as follows:

- Hooter - alarm annunciations
- Bell - Annunciation of DC failure
- Buzzer - AC supply failure.

**f) Sequence of operation of the annunciator shall be as follows:**

<table>
<thead>
<tr>
<th>Alarm condition</th>
<th>Fault contact</th>
<th>Visual Annunciation</th>
<th>Audible Annunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal</td>
<td>Open</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>2. Abnormal</td>
<td>Close</td>
<td>Flashing</td>
<td>On</td>
</tr>
<tr>
<td>3. Acknowledge push button is pressed</td>
<td>Close</td>
<td>Steady on</td>
<td>Off</td>
</tr>
<tr>
<td>4. Reset push button is pressed</td>
<td>Close/ Open</td>
<td>On/ Off</td>
<td>Off</td>
</tr>
<tr>
<td>5. Lamp test push button pressed</td>
<td>Open</td>
<td>Steady on</td>
<td>Off</td>
</tr>
</tbody>
</table>

**g) Visual and audible annunciation for the failure of DC supply to the annunciation system shall also be provided and this annunciation shall operate on 240 volts AC supply with separate fuses. On failure of the power supply to the annunciation system for more than 3 secs. (adjustable setting) an indicating lamp shall light up and a bell shall sound. A separate push button shall be provided for cancellation of this audible alarm alone but the indicating lamp shall remain steadily lighted till the supply to the annunciation system is restored. The sound of the audible alarm (bell) provided for this annunciation shall be different from the audible alarm provided for the annunciation system.**

**h) A separate voltage check relay shall be provided to monitor the failure of supply (240 V AC) to the scheme mentioned above. If the failure of supply exists for more than 2 to 3 secs. this relay shall initiate visual and audible annunciation. The visual and audible annunciation for the failure of AC supply shall be connected to the annunciation system and this shall operated on DC and buzzers shall sound. The annunciation system described above shall meet the following additional requirements:**

**i) The annunciation system shall be capable of catering to all simultaneous signals at a time.**

**ii) One self resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation supply failure monitoring circuit shall also be provided. These testing circuits shall be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land during the test.**

**iii) One set each of the following push buttons shall be provided on each panel**

a) Reset push button for annunciation system
b) Accept push button for annunciation system

**iv) The annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of the fleeting signal registered by the system shall be 15 milli secs.**
v) The annunciator shall be suitable for operation with normally open fault contacts which close on a fault. For fault contacts which open on a fault, it shall be possible at site to change annunciators from "close to fault" and vice versa.

vi) Micro Processor based alarm and annunciation relay schemes are preferable.

vii) In case of static enunciator scheme, special precaution shall be taken to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels and the static annunciator shall meet the high voltage susceptibility test, impulse voltage with stand test, high frequency disturbance test – class III and fast transient disturbance test-level III as per IEC 60255.

8.4 Switches:

a) Control and Instrument switches shall be rotary operated type with Escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out. Handles of different shapes and suitable inscriptions on switches as per clause 5.1.7 shall be provided as on aid switch identification. The connection shall be from the back. The contact assembly at the back of the switch shall be enclosed in a dust proof removable covers. The access to the cover shall be from the back, by removal of nuts.

b) The selection of operating handles for the different types of switches shall be as follows:
   i. Breaker and isolator : Control switch with pistol grip(black)/ control switch with discrepancy lamp, switches
   ii. Selector switches : Oval or knob, black
   iii. Instrument switches : Round, knurled, black
   iv. Protecting transfer : Pistol grip, lockable switch and black
   v. Synchronizing switches : Oval, Black, keyed handle

c) The control switch of breaker and isolator shall be of 3 position 12 ways spring return to neutral type, with lost motion device with locking facility. The spring return type shall be provided with target which shall indicate the last operation of the switch. The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively. Adequate number of spare contacts shall be provided on breaker control switches for control, inter locking, annunciation and discrepancy.

d) Instrument selection switches shall be of maintained contact (stay put) type Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondaries when changing the position of the switch. They shall be of 5 position type viz R-Y-B-N-Off. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltages for non-effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

e) Synchronizing selector switches shall be maintained contact (stay put) type and provided on the Synchronous Trolley. Synchronising sockets (12 pin type) matching with the 12 pin Plug of Synchronous Trolley cable shall be fixed on each breaker panel. The synchronizing selector switch (on the trolley) and socket (on the panel) combination shall be arranged to connect the Synchronizing equipment when turned to the "ON" position. One contact of each socket shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the "ON" position.
f) Lockable type of selector switch which can be locked in particular positions shall be provided on the trolley. The key locks shall be fitted on the operating handles.

g) The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver. Springs shall not be used as current carrying parts. The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme. The contact rating of the switches shall be as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Contact rating in Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>220/110 V DC</td>
</tr>
<tr>
<td>a) Make and carry continuously</td>
<td>10</td>
</tr>
<tr>
<td>b) Make and carry for 0.5 sec.</td>
<td>30</td>
</tr>
<tr>
<td>c) Break</td>
<td></td>
</tr>
<tr>
<td>i) Resistive load</td>
<td>3</td>
</tr>
<tr>
<td>ii) Inductive load with L/R = 40 m sec</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Discrepancy Switches

As an alternate to the pistol grip type control switch the bidder can offer control switch with discrepancy lamp. Control switch with discrepancy lamp shall be used for the remote operations like closing and tripping the circuit breakers or closing and opening of the isolator. The built in lamp shall be connected to the annunciation for any discrepancy between the position of the switches and controlled objects. Suitable flasher relay shall also be included in the scope. The discrepancy switches shall be black in colour and knob type with in-built lamp. Wherever discrepancy switches are provided the bidder shall provide necessary auxiliary relays for interlock schemes.

8.5 Indicating Lamps:

a) Indicating lamps shall be panel mounting type with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, un-breakable and moulded from heat resisting material. The lamps shall be of LED type. The supply for LED shall be from DC station batteries, unless stated otherwise, at 220/110V.

b) The wattage and resistance of the lamps shall be as follows:
   i) 220/250 V – 5 to 10 W – 4000 to 8000 Ohms
   ii) 110 V – 5 to 10 W – 1000 to 2000 Ohms

c) Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.
d) The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.
e) LED shall be furnished 20% in excess of actual numbers required and caps shall be furnished 10% in excess of actual numbers used for each colour. The corresponding breaker position of indicating lamps shall flash for condition of discrepancy between the last operation of circuit breaker (ON and OFF) and become steady when the switch is operated to correspond with the position of the circuit breaker. The discrepancy signal when the breaker is tripped shall also be followed by the sound signal.

8.6 Position Indicators:

a) Position indicators of ‘SEMAPHORE’ type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.
b) Position indicator shall be suitable for either AC or DC operation as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure. The rating of the indicator shall not exceed 2.5 W. It shall not be possible to displace the position of the indicator discs due to the accidental touch during the cleaning of the panel.
c) The position indicators shall withstand 120% of rated voltage on a continuous basis.

8.7 Synchronizing Equipments:

a) 1 No. Synchronizing switch and 1 No. 12 pin Synchronizing socket is to be provided on 220/33 kV feeder control panels and shall be supplied along with panels. Depending on the actual requirement either Synchronizing switch or Synchronizing sockets or both will have to be mounted and wired on the panel.
b) The synchronizing instruments shall be mounted on a synchronizing trolley. The trolley shall be equipped with double voltmeter, double frequency meter, synchroscope and lamps fully wired. The trolley shall be of mobile type with four rubber padding wheels capable of rotating in 360° round the vertical axis. Suitable bumpers with rubber paddings shall be provided all round the trolley to prevent any accidental damage to any panel while the trolley is in movement.
c) The trolley shall have 3 meter long flexible cord comprising stranded tinned copper conductors fully wired to the instruments and terminated in plug in order to facilitate connecting the trolley to any of the panels. The trolley shall be provided with all equipment/accessories necessary for proper synchronization. Receptacle to accept the plug shall be provided on each control panel. Suitable auxiliary voltage transformers wherever necessary shall also be provided for synchronizing condition.
d) Synchroscope shall be suitable for 110√3 v phase to neutral VT secondaries and shall be provided with integral synchronism indicating lamp employing bright bulb synchronizing method.
The synchroscope shall indicate synchronism between incoming and running supplies when pointer is at the time ‘twelve O’clock’ position only and shall have arrows on the face to show that the incoming supply frequency is fast or slow with respect to the running supply frequency when the pointer is moving clockwise or anti-clockwise respectively. The instrument pointer shall move at least 45° from the vertical position when either or both supplies are removed and then remain stationary without any tendency to creep.

The synchroscope shall be 360° type and preferably be larger in size than other instruments. It shall be capable of withstanding sustained out-of-synchronism conditions. In case the synchroscope is not continuously rated, a synchroscope cut-off switch shall be provided and an indicating lamp to indicate that the synchroscope is energized, shall also be provided.

e) Synchro check relay with necessary ancillary equipment shall be provided which shall permit 220kV breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 35° and this angle shall be adjustable and take into account the circuit breaker closing system period. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met with in present limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a voltage difference setting not exceeding 10% at rated value. The relay shall have a continuously adjusted time setting range of 0.5 to 20 sec. A guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The synchronizing by pass switch shall also be provided.

8.8 Trip circuit supervision relays:

a) Trip circuit shall be supervised by means of relays. The scheme shall continuously monitor each trip coil in both pre-close and after-close of the breaker. The scheme shall detect. i) Failure of DC supply to each trip coil. ii) Open circuit of trip circuit wiring and iii) Failure of mechanism to complete the tripping operation.

b) The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the control panel for visual and audible indication of the failure of trip circuit and for connection to event logger. The relay shall have time delay on drop off of not less than 200 milli seconds and be provided with operation indications for each phase. Trip circuit supervision relay shall be provided for each pole of breaker for each DC source.

c) Also 2 Nos. indicating lamps to act in conjunction with trip circuit supervision relays for healthy trip indication of 2 sets of trip coils shall be supplied.

d) Necessary external resistors for trip circuit supervision relays shall be supplied.

8.9 High speed tripping relay shall.

i) be instantaneous (operating time not to exceed 10 milli seconds)

ii) Be DC operated

iii) Have adequate hand resetting type contacts, preferably operated by push button. The resetting time shall be with in 20 milli seconds for self resetting relays.

iv) Have necessary supervisory relays
v) Be provided with operation indicators for each element/coil.
vi) Have adequate contacts to meet entire requirement of the scheme, with two spare contacts.

8.10 Flag relays shall have

i) Hand reset flag indication
ii) Two elements
iii) Have necessary NO/NC contacts for each element/coil to meet scheme requirements.

8.11 Voltage selection scheme for 220 & 33 kV circuits:

A suitable scheme shall be provided for each 220 kV & 33 kV circuit to select approximate bus voltages for protection and metering purpose. The scheme shall use auxiliary contacts of bus isolators and circuit breakers. It shall ensure that there is no interruption of supply to the protection and metering circuits while change over is taking place.

8.12 Auxiliary Monitoring relays

a) Self reset auxiliary / monitoring voltages relays for specified D.C. voltage shall be provided for use in the interlocking schemes for multiplication of contacts, and for monitoring of control supplied and circuit. Monitoring relays for lockout relay circuit shall be connected in series with lockout relay coils. The bidder shall be responsible to ensure that the monitoring relay ratings are such that they shall positively pick-up through the breaker coils / lockout relay coils monitored, but the breakers / lockout relays shall not operate with such a connection.
b) The supply and circuit monitoring relay shall be connected to initiate an alarm upon failure of respective supply circuit. They shall preferably have reverse flags, which drop when the relay is de-energized. Otherwise, an indicating lamp shall be provided with each monitoring relay for indication of its operation.

8.13 D.C. Supply Supervision Relay

The relay shall be capable of monitoring the failure of D.C. supply to which it is connected. It shall have adequate potential free contacts to meet the scheme requirement. The relay shall have a “time delay on drop-off” of not less than 100 milliseconds and be provided with operation indicator / flag.

8.14 (A) Non-directional Over Current relay for back up protection

i) be single pole type
ii) have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
iii) Have a variable setting range of 50 -200% of rated current with adjustable time multiplier settings.
iv) Have a characteristic angle of 45°., directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 500-2000% of rated current. Both the inverse and high set relays shall be non-directional.
v) Include hand reset flag indicators per phase.
vi) Shall be numerical type.
(B) Directional Over Current relay for back up protection (For transmission lines)

i) Be single pole type
ii) Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
iii) Have a variable setting range of 50 -200% of rated current with adjustable time multiplier settings.
iv) Have a characteristic angle of 45°., directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 500-2000% of rated current. Both the inverse and high set relays shall be directional.
v) Include hand reset flag indicators per phase.
vi) Shall be numerical type.

8.15 A) Directional earth fault relay for back up protection (for lines and transformers)

i.) be single pole type
ii.) have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
iii.) Have a variable setting range of 20-80% of rated current with adjustable time multiplier settings
iv.) Have a characteristic angle of 45°., directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 200-800% of rated current. Both the inverse and high set relays shall be directional
v.) Include hand reset flag indicators per phase.
vi.) Shall be numerical type

B) Non-Directional earth fault relay for back up protection

i.) be single pole type
ii.) have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
iii.) Have a variable setting range of 20-80% of rated current with adjustable time multiplier settings
iv.) Have a characteristic angle of 45°., directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 200-800% of rated current. Both the inverse and high set relays shall be non-directional
v.) Include hand reset flag indicators per phase.
vi.) Shall be numerical type

8.16 Trip Transfer Scheme:

In order to energize master trip relay of bus coupler through master trip relay of line/Transformer a trip transfer scheme will be provided for transferring the tripping signal to the bus coupler breaker whenever any Line/transformer is connected to the auxiliary bus. The necessary switching arrangement shall be provided as per the requirement of the scheme.
9.0 DETAILED DESCRIPTION OF PROTECTIONS:

The protection, auxiliary relay and timers and other equipment that are required to be provided are included in the detailed equipment schedule of panels vide Annexure-V2-P3-S1-1 of this specification. The detailed description of each protection and the associated equipment is described below:

The setting ranges of relays given in specification are indicative. The setting ranges of the equipment offered, if different from the ones specified, shall also be acceptable if they met the functional requirements.

The bidder shall quote the protection equipment meeting the following requirements. Separately the bidder may also quote for any additional protections or relays of their own make considered necessary by him for providing complete, effective and reliable protection. These equipment shall be quoted separately as an addition to the main offer stating the price in the price schedule only. The choice of acceptance or otherwise of this alternative/additional equipment shall rest with the RSDCL.

9.1

9.2

9.3

9.4 100 MVA 220/33 kV Power Transformer Protection:

The protection scheme proposed to be adopted for 220/33 KV Power transformers will be as under:

a) Main-I: Numerical full scheme Differential protection and have facility for connecting to substation control system/SCADA.
b) Main-II (other make as that of Main-I): Numerical full scheme Differential protection and have facility for connecting to substation control system/SCADA.
c) HV and LV Restricted earth fault protection
d) Inverse over current back-up protection for phase faults with instantaneous attachment.
e) Inverse backup protection for ground faults with instantaneous attachment.
f) High temperature winding protection.
g) High Temperature oil protection.
i) Buchholz protection for transformer and OLTC.
j) Voltage Neutral displacement relay for tertiary protection.
k) Over-fluxing protection.
l) Pressure release device (PRD)

9.4.1 Numerical Transformer differential protection scheme shall

(a) be triple pole type, with faulty phase identification/ indication
(b) have an operating time not greater than 30 milli seconds at 5 times the rated current.
(c) have three instantaneous high set over-current units
(d) have an adjustable bias setting range of 20-50%
(e) be suitable for rated current of 1 Amp.
(f) have second harmonic or other inrush proof features and also should be stable under normal over fluxing conditions. Magnetizing inrush proof feature shall not be achieved through any intentional time delay e.g use of timers to block relay operation or using disc operated relays

(g) have an operating current setting of 15% or less

(g) include necessary separate interposing current transformers for angle and ratio correction or have internal feature in the relay to take care of the angle & ratio correction

(h) have a disturbance recording feature to record graphic form of instantaneous values of current in all two windings in nine analogue channels in case of 400kv class and above transformers and 6 analogue channels for lower voltage transformers, during faults and disturbances for the pre fault and post fault period. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay.

1.  REF protection operated
2.  HV breaker status (Main and tie)
3.  LV breaker status
4.  Bucholz /OLTC Bucholz alarm / trip
5.  WTI/OTI/PRD alarm/trip of transformer

Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer available in the substation shall be included in the scope.

9.4.2 Over fluxing protection Relays shall

(a) operate on the principle of Voltage to frequency ratio and shall be phase to phase connected

(b) have inverse time characteristics, matching with transformer over fluxing withstand capability curve.

(c) provide an independent 'alarm' with the time delay continuously adjustable between 0.1 to 6.0 seconds at values of 'v/f' between 100% to 130% of rated values

(d) tripping time shall be governed by 'v/f' Vs. time characteristics of the relay

(e) have a set of characteristics for Various time multiplier settings. The maximum operating time of the relay shall not exceed 3 seconds and 1.5 seconds at 'v/f' values of 1.4 and 1.5 times, the rated values, respectively.

(f) have an accuracy of operating time, better than ±10%.

(g) have a resetting ratio of 95 % or better.

(h) Be acceptable as a built in feature of numerical transformer differential relay

9.4.3 Numerical Restricted Earth Fault Protection shall

(a) be single pole type

(b) be of current/voltage operated high impedance type

(c) have a current setting range of 10-40% of 1 Amp./ have a suitable voltage setting range.

(d) be tuned to the system frequency

Note : Each 220/33 kV Power transformer details (as specified in ANNEXURE –V2-P3-S1-2) shall be provided with double core identical current transformers for various protections mentioned above in the following manner reproduced below:
1. Three Nos. on HV winding Bushing (One No. per phase)
2. Three Nos. on LV winding Bushing (One No. per phase)
3. Three Nos. on neutral end (One No. per phase before neutral formation of HV and LV winding)
4. One no. on each neutral.

9.4.4 **Numerical Back-up Over Current and Earth fault protection scheme with high set feature**

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).

(b) The scheme shall include necessary VT fuse failure relays for alarm purposes

(c) Over current relay shall
   - have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current
   - have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000% of rated current
   - have a characteristic angle of 30/45 degree lead
   - include hand reset flag indicators or LEDs.

(d) Earth fault relay shall
   - have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
   - have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800% of rated current
   - have a characteristic angle of 45/60 degree lag include hand reset flag indicators or LEDs
   - include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

9.4.5 **Transformer Overload Protection Relay** shall

(a) be of single pole type
(b) be of definite time over-current type
(c) have one set of over-current relay element, with continuously adjustable setting range of 50-200% of rated current
(d) have one adjustable time delay relay for alarm having setting range of 1 to 10.0 seconds, continuously.
(e) have a drop-off/pick-up ratio greater than 95%.
(f) be acceptable as built in feature of numerical transformer differential relay

9.4.6 **Neutral Displacement Relay**: The voltage neutral displacement relay will be connected to the open delta terminals of the 33kV PT secondary 3P core. The neutral displacement relay will have IDMT characteristics with setting range of 5% to 20% of rated voltage of 110 V

9.4.7 **Auxiliary relays for transformer protection devices**: Separate auxiliary relays for the following function for each transformer shall be provided:
i) 4 Nos. for tripping on Buchholz alarms and trips.
ii) 3 Nos. OLTC diverter switch oil surge trip and 1 common OLTC oil surge trip.
iii) 2 Nos. winding temperature trip on two windings.
iv) 1 No. oil temperature trip.
v) 2 Nos. pressure release device trip.
vi) 2 Nos. spares.

Two Gas detector relays have been provided with each of the above mentioned transformers and each relay will have one pair of alarm contacts and one pair of tripping contacts all of which shall be used for tripping the transformer.

OLTCs are equipped with oil surge type relays with tripping contacts. Similarly winding temperature indicators have been provided on HV & LV windings of the transformers which have two pairs of actuating contacts for winding temperature alarm and trip. The auxiliary tripping relays shall be provided to trip simultaneously the incoming & the outgoing circuits of the transformers in conjunction with the main tripping contacts.

The auxiliary relay should have relay connecting fingers/ strips/Pins /plug capable of carrying 30A for 3 sec. & 5A continuously at 660 V.

9.4.8 Inter tripping relays:

1 No. inter-trip relay to trip HV and LV breakers of the transformer and to isolate the transformer from supply shall be supplied. The inter trip relay shall be of high speed and shall be provided with hand reset operation indicator and 4 N/O + 2 N/C hand reset contacts for 220 kV breaker.

9.5 220 kV LINE PROTECTION:

9.5.1 The protection scheme offered shall be suitable for 220 kV three phase lines.
9.5.2 The line protection relays are required to protect and clear the faults with reliability, selectively for all type of faults under all system conditions in the shortest possible time to ensure system stability.
9.5.3 The maximum fault current could be as high as 40 kA but the minimum fault current could be as low as 20% of rated current of CT secondary. The starting & measuring relays characteristics should be satisfactory under these extremely varying conditions.
9.5.4 The protection schemes shall co-ordinate with the carrier schemes.
9.5.5 The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.
9.5.6 The Main-I and Main-II protection schemes of the transmission line shall be of different makes to avoid the common mode failures. However, they may be of same make but of different models.
9.5.7 The scheme shall be provided with following protection functions for each of the transmission lines.
9.5.7.1 Main-I: Numerical full scheme differential & distance protection for use with OPTICAL FIBRE/ PLCC scheme (permissive under-reach and over-reach blocking) and have facility for connecting to substation control system/SCADA.
9.5.7.2  Main-II: Numerical full scheme distance protection for use with PLCC scheme (permissive under-reach and over-reach blocking) and have facility for connecting to substation control system/SCADA.

9.5.7.3  Back-up Directional Over current and Earth fault protection (Numerical type) with non-directional facility.

9.5.7.4  The detailed specifications of the above line protection scheme is given here under:-

9.5.8.1  Main-I & Main-II: These protections

i)  Shall be numerical type & modular in construction

ii) Shall be non-switched type with separate zone measurements for all phase to phase and phase to ground faults. Zone switching to extend the reach of the measuring elements is also not allowed.

iii) Shall be high speed full scheme distance relay for three phase systems to clear all type of line faults within the set reach of the relay.

iv) Shall have stepped time-distance characteristics and three independent zones (zonal 1, Zone 2 and Zone3)

v)  Shall have mho or quadrilateral or other suitably shaped characteristics for zone1, zone2, zone3.

vi) The relay shall have an adjustable characteristics angle setting range of 30 to 85 degree or shall have independent resistance and reactance (X) setting.

vii) Shall have two independent continuously variable time setting range of 0 to 3 seconds for zone-2 and 0 to 5 second for zone-3.

viii) Shall have resetting time of less than 55 miliseconds or lower (including the resetting time of trip relays).

ix)  Shall have facilities for offset features with adjustable 10-20% of zone-3 setting.

x)  Shall have variable residual compensation.

xi)  Shall have memory circuits with defined characteristics in all three phases to ensure correct operations during close-up phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero volt 3 phase fault.

xii) The resistive reach shall be separately settable for phase-phase and phase-ground faults for each zone.

xiii) It shall also have a facility to store different settings suitable for different configurations to cater for mutual coupling on account of multi circuit line conditions.

xiv)  have the following built in features

1.  Power swing Block – which blocks tripping during power swing conditions and have suitable setting range to encircle the distance protection described above.

2.  Fuse failure protection shall—

    • monitor all the three fuses of CVT and associated cable against open circuit.
    • Inhibit trip circuits on operation and initiate annunciation.
    • Have an operating time less than 7 miliseconds.
    • Remain inoperative for system earth faults.

3.  Weak end infeed and current reversal logic.

4.  Stub protection

5.  Phase selection features for single pole auto-reclosure & cross country faults

6.  Power system monitoring in terms of

   a)  Broken conductor detection
   b)  Overload

xv)  be suitable for single and three phase tripping.
xvi) shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with CVT being used on line (With all filters included).

<table>
<thead>
<tr>
<th></th>
<th>Source to Impedance Ratio(SIR)</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Relay setting(Ohms)</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Fault Location</td>
<td>60%</td>
</tr>
<tr>
<td>4</td>
<td>Fault Resistance(Ohms)</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Maximum operating time(m.sec)</td>
<td>45 for all faults</td>
</tr>
</tbody>
</table>

xvii) The scheme shall be suitable for various overreaching, under-reaching and blocking communication schemes.

xviii) The Scheme shall be provided with continuous self supervision features along with self diagnostic feature.

xix) The scheme shall provide the user with complete information on at least latest 5 disturbances. Facility for retrieving this information remotely shall have to be possible.

xx) Service values of voltage, current, frequency, active power and reactive power shall be available. Pre-fault and fault values of currents and voltages must be available for fault analyzing purposes. Facility to have remote communication for the purpose of parameterization and reading service values should be possible with suitable software and hardware.

xxi) Shall have suitable number of potential free contacts for carrier aided Tripping, Auto reclosing, Event Logging, Disturbance recorder & data acquisition system.

xxii) The scheme shall have built-in event recorder, which can record at least 100 events with the time resolution of 1 msec.

xxiii) The scheme shall have capability to time synchronize with the external GPS signal/SNTP.

xxiv) The scheme shall have adequate serial and fibre optic communication ports for communication. The ports shall be used for configuration of the relay and disturbance data monitoring from local/remote and for the purpose of communicating to substation SCADA. All the necessary software and hardware required for remote configuration and for disturbance analysis shall be in the scope of the supplier.

xxv) The local and remote communications shall be as per internationally acceptable specified IEC protocols.

xxvi) The scheme shall be provided with a front mounted menu driven human-machine-interface and/or local front port for local parameterization with suitable security provisions for unauthorized access to settings.

xxvii) Shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.

xxviii) Shall be provided with necessary self reset type trip duty contacts for completion of the scheme (minimum number of these trip duty contacts shall be four per phase) either through built in or through separate high speed trip relays. Making capacity of these trip contacts shall be 30 Amps. For 0.2 seconds with an inductive load of L/R > 10 milliseconds. If separate high speed trip relays are used, the operating time of the same shall not be more than 10 milliseconds.
1. Back-up Directional over Current and Earth fault Protection Scheme: This shall, have three over current and one earth fault elements(s) which shall be either independent or composite unit(s).

2. shall be numerical type.

3. shall include necessary CVT fuse failure relays for alarm purposes.

4. Directional over current relay (with facility of non-directional):
   - have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting.
   - Have a variable setting range of 50-200% of rated current.
   - Have a characteristic angle of 30/45 degree lead.
   - Include hand reset flag indicators or LEDs

5. Directional Earth fault relay(with facility of non-directional):
   - Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times.
   - Have a variable setting range 20-80% of rated current.
   - Have characteristic angle of 45/60 degree lag.
   - Include hand reset flag indicator or LEDs
   - Include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.

9.5.8.2 LINE OVER VOLTAGE PROTECTION

1. This shall monitor all three phases.

2. Have two independent stages.

3. Have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage.

4. Have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 milli seconds for the second stage.

5. Be tuned to power frequency.

6. Provided with separate operation indicators (flag target) for each stage relays.

7. Have a drop-off to pick-up ratio greater than 95%.

8. Provide separate out-put contacts for each ‘Phase’ and stage for breaker trip relays, event logger and other scheme requirements

9.5.8.3 DISTURBANCE RECORDING: The disturbance recorder function shall have following features:

1. Disturbance recorder shall be able to record continuously and will have 8 analogue inputs and 32 digital inputs.

2. Disturbance Recorder shall have a scan rate of 1 KHz or better.

3. It should be possible to trigger the recorder from any analogue inputs (Over and/or Under Voltage / Current) and on any digital input.

4. Disturbance recorder shall have provision to accept external signals for triggering.

5. Disturbance recorder shall have adjustable pre-fault and post fault time settings.

6. Total recording time shall be 20 sec
**9.5.8.4** FAULT LOCATOR: The fault location function shall:

1. Microprocessor base type
2. be “On-Line” type
3. be suitable for breaker operating time of 2 cycles.
4. have built in display unit
5. the display shall be directly in percent of line length or Kilometers without requiring the further calculations.
6. have an accuracy of 3% or better for the typical conditions defined for operating timings measurements of distance relay.
7. The above accuracy should not be impaired under the following conditions:
   - Presence of remote end in-feed
   - Predominant D.C. component in fault current
   - High fault arc resistance
   - Severe CVT Transients.
8. shall have mutual zero sequence compensation unit for fault locator to be used on double circuit lines.

**9.6.1 LOCAL BREAKER BACK-UP PROTECTION SCHEME** shall

(a) be triple pole type
(b) have an operating time of less than 15 milli seconds
(c) have a resetting time of less than 15 milli seconds
(d) have three over current elements
(e) be arranged to get individual initiation from the corresponding phase of main protections of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer /reactor equipment protections
(f) have a setting range of 20-80% of rated current
(g) have a continuous thermal withstand two times rated current irrespective of the setting
(h) have a timer with continuously adjustable setting range of 0.1-1 seconds
(i) have necessary auxiliary relays to make a comprehensive scheme.

**9.6.2 TRIP CIRCUIT SUPERVISION RELAY**

(a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
(b) The relay shall have adequate contacts for providing connection to alarm and event logger.
(c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase.

**9.7 220 kV BUSBAR PROTECTION:**

9.7.1 The scheme is required for busbar protection in the substations. Security and stability are key requirements of a busbar protection scheme. It shall be capable of accommodating different busbar configurations, operating quickly and reliably on internal (bus) faults and remaining stable during external faults. It shall be able to provide back up protection on circuit breaker/equipment failures, self supervision and monitoring and diagnostic features.
9.7.2 The equipment should be so designed that it is immune to high level electrical disturbance present in the switchyard and control room.

9.7.3 Numerical Busbar Protection Scheme: The scheme shall have following features:

9.7.3.1 STANDARDS:–

1) Dielectric Test:-
   i) IEC 60255-5, 2 kV rms for 1 min between all circuits and the case, and between all separate circuits.
   ii) ANSI / IEEE C37.90-1989, 1 kV rms for 1 min across open contacts.
   iii) High voltage impulse : IEC 060255-5; 1977, 5 kV (peak), 1.2/50 ms, 0.5 J, 3 positive and 3 negative impulses between all terminals and all terminals and case earths.

2). Electrical Environment:-
   i) High frequency disturbances IEC 60255-22-1: 1998 Class III.
   iii) Surge Immunity IEC 61000-4-5.
   v) Fast transient disturbance, IEC 60255-22-4:1992 Class IV.
   vi) Fast transient disturbance, IEC 60255-22-4, Class IV.
   vii) Power frequency magnetic field immunity IEC 61000-4-8, Class IV.
   viii) Radiated immunity / radio frequency immunity IEC 60255-4-3, Class III.

3). Atmospheric Environment:–
   i) Temperature, IEC 60255-6, - 10°C to +55°C (in operation) & -25°C to +70°C (during transport & storage).
   iii) Climate tests, IEC 60068-2-1, 60068-2-2.
   iv) Enclosure protection IP 52.

4) Mechanical Environment:-
   i) Vibration IEC 60255-21-1.
   iii) Seismic, IEC 60255-21-3.

9.7.3.2 General Features:–
The Bus bar protection scheme shall:-

i) Be high speed low impedance phase segregated biased differential current type and have operate and restrain characteristics.

ii) Be of modular construction and have features of self monitoring, supervision and diagnostic capabilities to ensure maximum availability of scheme.

iii) Have fully numerical signal processing.

iv) Operate selectively for each zone of bus bar.

v) Not give false operation during normal load flow in bus bars.

vi) Incorporate suitable algorithm to remain stable during external fault conditions.

vii) Have integrated check zone supervision element.

viii) Incorporate clear zone indication.

ix) Incorporate continuous supervision for CT secondaries against any possible open circuit and if it occurs, scheme shall render the relevant zone of protection in-
operative and shall give facial annunciation for it, zonal protection contact shall be
by-passed automatically and the effected zone shall be protected by check zone only.

x) Have through fault stability in spite of C.T. Saturation.

xi) Be able to accommodate different / heterogeneous CT classes, constructions, ratios
without the need of auxiliary CT’s for ratio matching. It shall be capable to integrate
existing CT’s available or using the common secondary core of other protection
also.

xii) Be transient free in operation.

xiii) Include continuous internal DC supply supervision.

xiv) Include protection “in/out” switch for each zone with at least six contacts for each
switch.

xv) Have built in local breaker failure protection for each feeder. It shall also have
option to take initiation input from the other protective relays in the feeders.

xvi) Capability to detect fault in dead zone (between circuit breaker and the associated
CT’s) dynamically depending on system condition.
Have fiber optic wiring between central and peripheral / bay units to exchange data
fast, reliability and immunity from electromagnetic interference.

xvii) Have a separate sensitive earth fault protection for networks with high impedance
earthing. It shall be controlled by bias current to ensure stability on external faults
and phase segregated differential protection.

xx) Have a non-directional back-up over current and earth fault protection functions
with definite / IDMT characteristics for individual feeders.

xxi) Have facility for recording fault, event and disturbance must be saved in battery
backed memory for each feeder with time tagged to 1 ms using an internal real time
clock.

xxii) Have facility to synchronize its time reference with external GPS signal/. It shall be
capable of synchronizing through IRIG-B Signal of GPS/ SNTP.

xxiii) Give 100% security up to 40 kA fault level.

xxiv) Not require CT switching. It shall be capable of schematic replication of the sub-
station showing bus configuration with status of various equipments.

xxv) Have associated software (s) required for schematic replication, settings,
configurations, logic programming, extraction and viewing of events, faults etc. It
shall be loaded on the Man-machine interface (MMI) i.e. PC.

xxvi) Be capable of communicating with station SCADA on IEC- 61850.

xxvii) Have all inter bus communications, remote communications are to be made on
universally acceptable IEC 60870-5-103/open protocol. It shall also have suitable
communication interfaces for connecting to local MMI.

xxviii) Ensure checking of multiple conditions like biased differential element, overall check
zone, CT saturation, CT secondary open circuit, and individual feeder settings etc.
before making trip decision.

9.7.3.3 Technical Parameters:

(i) Busbar Protection Operating Time: The maximum operating type upto trip impulse to
trip relay for all types of faults is 15 m.Sec or better at 5 times setting value.

(ii) Auxiliary Supply (both for Main and Peripheral/Bay Unit): 220/110 Vdc.

(iii) The sufficient numbers of opto-isolated binary inputs and durable Output
relays/contacts for tripping, annunciation, watchdog etc. (as per design requirement at
each site) shall be provided in Main and Peripheral/ Bay units. The Voltage range for binary input shall be 24 V to 250Vdc. The relay contacts shall be heavy duty type and capable of,

\[
\text{Make: 30 A and carry for 0.5 s}
\]
\[
\text{Carry: 8 A or better Continuous}
\]

(iv) Analog Inputs: AC Current (In) shall be 1 A/ 5A Dual Rated types, with thermal withstand Capacity as Continuous: 4x In, for 10 S: 30 x In and 1 S: 100 x In.

(v) Rated frequency shall be 50 Hz.

(vi) The Event Recording of atleast 250 events shall be required.

(vii) The fault recorder shall be able to record at least last 4 Nos. of fault records.

(viii) The internal Disturbance recording shall be able to record disturbances at bay and main unit levels. Sufficient number of analog channels, binary inputs to record at least 15 Nos. of disturbances at the sampling speed of 600 Hz. The channels and trigger sources shall be user configurable. Disturbances can be extracted from the relay and saved in COMTRADE format for analysis on appropriate software utility.

(ix) User Interface: Main and Peripheral/Bay units shall have LCD Display with keypad for user configurations.

(x) LED Indications: Main and peripheral/bay units shall have sufficient number of LED (fixed as well as user configurable) for system health/operation indication.

(xi) Communication Interface:

a. 1 No. of RS-232 Interface in Main and each Peripheral/ Bay unit for connecting to PC for downloading/ monitoring.

b. Sufficient number of ST Connectors/ Interfaces in Main (2 Nos. Fiber Connectors for connecting to Substation SCADA and other as per requirement for connecting to peripheral/ bay units) and Peripheral/ Bay Units for interconnections.

(xii) The Peripheral/ Bay units are connected directly using two 820-850nm multi-mode optical fibers for each signaling channel. Multi-mode fiber type 62.5/125 µm, Max attenuation 8 dB with suitable and standard BFOC/2.5 type (ST) fibre optic connectors shall be used.

9.8 220 kV Bus-Coupler protection:

The protection provided on bus-coupler shall be inverse non-directional IDMTL relays for over current and earth fault. The over current and earth fault relays shall be numerical and communicable type.

9.9 33 kV PROTECTION (I/C, B/C, SECTIONLISER):

9.9.1 The protection provided on 33 KV system shall be inverse NON DIRECTIONAL IDMT relays for over current & earth fault.

9.9.2 The bay control unit shall have following protection feature:

1. Over current Instantaneous protection (ANSI 50)
2. Over Current definite time & IDMT (51 high, 51 low & 51 IDMT)
3. Earth Fault Definite time & IDMT (51N High, 51N Low, 51N IDMT)
4. Under-voltage instantaneous, definite time (27, 27 High, 27 Low)
5. Over-voltage Instantaneous, Definite time (59, 59 High, 59 low)
10.0 TIME SYNCHRONISATION EQUIPMENT: It is in SAS specification.

11.0 TESTS

11.1.0 Type Test:

The reports for following type tests shall be submitted by the bidder for the Protective relays

a) Insulation tests as per IEC 60255-5
b) High frequency disturbance test as per IEC 60255-4 (Appendix-E) Class III (not applicable for electromechanical relays)
c) Fast transient test as per IEC 100-4, Level III (not applicable for electromechanical relays)
d) Relay characteristics, performance and accuracy test as per IEC 60255

Steady state Characteristics and operating time
Dynamic characteristics and operating time for distance protection relays and current differential protection relays

e) Tests for thermal and mechanical requirements as per IEC 60255-6
f) Tests for rated burden as per IEC 60255-6
g) The offered IED’s shall have IEC-61850 conformance test conducted and certified at any accredited laboratory for IEC-61850.

11.1.1 The equipment/material offered in the bid should have been successfully type tested in line with Standard and Technical Specification within the last 5 (five) years from the date of opening of the bid. The bidder shall be required to submit 4 copies of the Type Test Reports along with the offer.

11.1.2 If there is any change in the components or design in the equipment since after earlier passing of the Type Test, the bidder shall bring out in his offer all such changes made in components, materials, designs etc. In such case the bidder shall carry out the type tests at his cost and in presence of the purchaser's representative.

11.1.3 The purchaser reserves the right to conduct tests included in the list of Type Tests on requisite number of samples/items from any of the lots during the tenure of the supply, at purchaser’s cost in the presence of purchaser’s representatives. If the equipment/material does not withstand the type test, then the equipment/material supplied till then will be liable for rejection. The supplier, in such an eventuality, shall be allowed to modify the equipment and type test the same again at his cost in the presence of the purchaser’s representative. These type tests shall however be conducted by the supplier within a reasonable time. After successful passing of the type tests, all the equipments/materials supplied earlier shall be modified in line with the equipment/ materials which have successfully passed the type test. In case supplier fails to carry out the Type Test within reasonable time or does not agree to carry out the type test at his cost, his equipment/ material supplied earlier shall be rejected and order placed shall be cancelled and payments made earlier for these suppliers shall be recovered by the purchaser.
11.1.4 If the equipment/material offered in the bid has been type tested beyond 5 years from the date of opening of the bid, the bidder has to arrange for type testing the equipment/ material at no cost to the purchaser.

11.1.5 The type test clauses mentioned above are applicable for protective relays.

11.1.6 Notwithstanding anything stated above, the purchaser’s decision in this regard shall be final and binding on the bidder.

11.2.0 Routine Tests:

All routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of Purchaser’s representative without any extra cost.

11.2.1 Immediately after finalization of the programme of routine testing the supplier shall give four weeks advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

11.2.2 The supplier shall carry out all the relevant physical verifications and functional tests at his works on all the finished Panels. Copies of these test certificates duly endorsed by the suppliers testing engineer shall be furnished to the Inspecting Officer of the Nigam. The Inspecting Officer reserves the right to insist for repetition of functional tests on any or all the panels offered for inspection and the supplier shall arrange for the same.

12.0 QUALITY ASSURANCE PLAN: As per tender document.

13.0 INSPECTION: As per tender document.

14.0 GUARANTEED TECHNICAL PARTICULARS:

The Guaranteed Technical particulars for the equipment being supplied shall be provided with the Bid as specified. The Bids received without guaranteed technical particulars shall be treated as Non-responsive.

15.0 DOCUMENTATION:

The bidder shall furnish the dimensioned drawings along with the bid indicating the details like components, make, quantity, ranges of meters, relays etc., in case the bidder quotes different makes of relays he shall furnish copies of wiring scheme and literature of all relays and sets of drawings and manuals shall be supplied along with each panel.

16.0 PACKING AND FORWARDING:

16.1 The panels shall be packed in suitable sized strong and weather resistant wooden cases / crates.

16.2 Suitable cushioning, protective padding or spacer shall be provided to prevent damage to or deformation of the components during transit and handling.

16.3 All packing cases shall be marked legibly and correctly with the contractors name and consignee's address so as to ensure their safe arrival at their destination and to avoid
possibility of goods being lost or wrongly dispatched on account of faulty or illegible marking.

17.0 CO-ORDINATION:

17.1 Details of Line configuration and other characteristics including communication facility will be furnished in detail to the successful contractor of this package, so that scheme of protection can be coordinated. Any matching current transformers required may be provided and the scheme of protection made reliable in operation. The Secondary ratings of current transformers are of 1A/5 Amps. and potential transformers' secondary voltages are: 110 V / 1.732 and 110 V.

17.2 The contractor shall also prepare and supply the coordination wiring diagrams between the control and relay panels and control switch gear as part of this contract.

17.3 The contractor shall coordinate in all respects with the manufacturers of associated equipment and shall freely exchange all relevant information to ensure satisfactory and economic over all design. No extra charge shall be payable for these services.

17.4 The contractor shall furnish full detailed instructions, complete with drawings and leaflets to enable satisfactory erection and commissioning of the plant. Such instructions should reach the Nigam sufficiently in advance of the receipt of the equipment in order that all the preliminary arrangement for the erection of the equipment can be made in advance so that there will be no delay in regard to erection as soon as the equipment is received.

18.0 TROPICAL TREATMENT:

18.1 Under the climatic conditions prevalent at the site, the equipment furnished under the specification will be subjected to operation under ambient temperatures of 50 deg. C and very high relative humidity. All equipment shall therefore, be suitably designed and treated for normal life and satisfactory operation under the hot and humid climatic conditions prevalent at site and shall be dust and vermin proof. All parts and surfaces which are subject to corrosion shall be made of such material and shall be provided with such protective finishes as would protect the equipment installed from any injurious effects of excessive humidity. All electrical auxiliary equipment shall be specifically treated for tropical conditions, and the materials and methods for this treatment shall be approved in advance by the Nigam.

19.0 FOUNDATIONS AND FIXTURES:

Foundations will be finalized, in accordance with the data to be supplied by the contractor. All fixtures necessary for proper erection of the embedded parts shall be supplied by the contractor.

20.0 SPARES: If required:

The bidder shall quote for the spare parts if indicated in the appropriate price schedule.
ANNEXURE –V2-P3-S1-1
SCHEDULE OF DETAILED EQUIPMENT

A. GENERAL SPECIFICATION OF SIMPLEX PANEL

Each simplex type integrated control relay panel / control panel / relay panel shall consist of the following:

Circuit label: 1 set
Door operated cubicle illumination: 1 No.
Terminal blocks with stud type terminal and 20% spare terminal: 1 set
Test Terminal Block for Energy Meter 1 Set
AC and DC fuses: 1 set
Terminal blocks with stud type terminal and 20% spare terminal: 1 set
Cable glands: 1 set
3 pin 15 AC plug socket with switch control: 1 set
Thermostat operated cubicle heater with switch control: 1 No.
Earth bus: 1 No.
Name plate for mounted equipment both on front panel and inside: 1 No.
Bell, Buzzer, Hooter: 1 Set.

The number of empty simplex/other types panels required to accommodate various equipment as specified in case of each of the panels designated below shall be supplied by the contractor at no extra cost. The price quoted for each type of panel is deemed to have included the price of number of empty panels required to accommodate above relays and protection.

B. CONFIGURATION OF C & R PANELS

Item No. 4 – 220 kV TRANSFORMER CONTROL PANELS (220 KV SIDE):
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION: PANEL ‘SAS-THCB’

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Circuit identification label:</td>
</tr>
<tr>
<td>ii</td>
<td>Mimic diagram and symbols</td>
</tr>
<tr>
<td>iii</td>
<td>Multifunction Panel Meter:</td>
</tr>
<tr>
<td>iv</td>
<td>Energy Meter (AC HT Static Trivector Meter TOD Type, Class 0.2s)</td>
</tr>
<tr>
<td>v</td>
<td>IEC-61850 Compliant Bay Control Unit:</td>
</tr>
<tr>
<td>vi</td>
<td>Trip circuit supervision relays suitable for both open and closed position of circuit breakers.</td>
</tr>
<tr>
<td>vii</td>
<td>Three position locking pattern control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of breaker with i) Close, ii) Normal &amp; iii) Trip position.</td>
</tr>
<tr>
<td>viii</td>
<td>24/36 way facia Annunciator scheme complete with</td>
</tr>
</tbody>
</table>
auxiliary relays and control switches as per specification with hooter & bell
(If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size Annunciator scheme to meet the functionalities).

ix) Three phase 4 wire link type test terminal block of current rating 15 amp for testing of trivector meters.

x) Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal

xi) Indicating LEDs for Breaker Position, Auto Trip & Healthiness

xii) Terminal Blocks

xiii) Auxiliary relay, CMR etc as required by the Scheme

xiv) Three position control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of Isolator with i) Close ii) Neutral & iii) Open position.

xv) Automatic semaphore indicator for circuit breaker, Isolator and Earth switches.

xvi) Other general equipments/features as per general specification of simplex panels.

-----------------------------------------------------------------------------------------------------------------------

Item No. 5 - 220 kV TRANSFORMER RELAY PANELS (FOR HV):
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-THRB’
-----------------------------------------------------------------------------------------------------------------------

i) Circuit identification label: 1 No.

ii) IEC-61850 Compliant Bay Protection Unit (Main Protection As per clause No. 9.4) [MAIN-I] 1 No.

iii) IEC-61850 Compliant Bay Protection Unit (Main Protection As per clause No. 9.4) [MAIN-II] 1 No.

iv) High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.

v) IEC Compliant BPU (Back Up Protection i.e. directional overcurrent & earth fault protection as per clause 9.4.4 of specification) 1 Set

vi) Voltage Selector Relay 1 Set

vii) IEC 61850 Compliant CB Protection [ Separate as per Clause 9.6] 1 Set

viii) Overfluxing Protection Scheme

ix) Overload Protection Scheme [Acceptable In Built Features of Main-I &II] 1 Set

x) REF Protection [Acceptable In Built Features of Main-I &II] 1 Set

xi) Neutral Displacement Protection [Acceptable In Built Features of Main-I &II] 1 Set
xii) DR, Fault [Acceptable In Built Features of Main-I &II] 1 Set
xiii) Lamp for DC fail Indication 1 No.
xiv) Push Button for DC fail accept 1 No.
 xv) Flag relays, auxiliary relay, CMR, timers etc including transformer alarms and trip functions as required by the Scheme. 1 LOT
xvi) DC Supervision Relay 1 Set
xvii) Test Blocks for relays 1 Set
xviii) Other general equipments/features as per general specification of simplex panels.

-----------------------------------------------------------------------------------------------------------------------

Item No. 6 - - 245 kV REACTOR CONTROL PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-RCB’

-----------------------------------------------------------------------------------------------------------------------
i) Circuit identification label: 1 No.
ii) Mimic diagram and symbols 1No.
iii) Multifunction Panel Meter: 1No.

v) IEC-61850 Compliant Bay Control Unit: 1 No. (having all functions such as control, supervisory, monitoring, measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities/ satisfactory operation of substation)
vi) Trip circuit supervision relays suitable for both open and closed position of circuit breakers. 6 Nos.

vii) Three position locking pattern control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of breaker with i) Close , ii) Normal & iii) Trip position.

viii) 24/36 way facia Annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size Annunciator scheme to meet the functionalities).

x) Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal

xi) Indicating LEDs for Breaker Position, Auto Trip & Healthiness 1 Set
xii) Terminal Blocks 1 Set
xiii) Auxiliary relay, CMR etc as required by the Scheme. 1 LOT
xiv) Three position control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of Isolator with i) Close , ii) Neutral & iii) Open position 4 Nos.
xv) Automatic semaphore indicator for circuit breaker, isolator and earth switches.

xvi) Other general equipments/features as per general specification of simplex panels.

Item No. 7 - 245 kV REACTOR RELAY PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-RRB’

i) Circuit identification label: 1 No.
ii) IEC-61850 Compliant Bay Protection Unit 1 No.
iii) IEC-61850 Compliant Bay Protection Unit (Main Protection As per clause No. 9.4) [MAIN-II] 1 No.
iv) High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme.
v) IEC Compliant BPU (Back Up Protection i.e. directional overcurrent & earth fault protection as per clause 9.4.4 of specification) 1 Set
vi) Voltage Selector Relay 1 Set
vii) IEC 61850 Compliant CB Protection [Separate as per Cl. 9.6] 1 Set
viii) Overload Protection Scheme 1 Set
ix) REF Protection 1 Set
x) DR, Fault 1 Set
xi) Lamp for DC fail Indication 1 No.
xii) Push Button for DC fail accept 1 No.
xiii) Flag relays, auxiliary relay, CMR, timers etc including transformer alarms and trip functions as required by the Scheme. 1 LOT
xiv) DC Supervision Relay 1 Set
xv) Test Blocks for relays 1 Set
xvi) Other general equipments/features as per general specification of simplex panels.

Item No. 8 - 220 kV FEEDER CONTROL PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION: PANEL ‘SAS-FCB’

i) Circuit identification label: 1 No.
ii) Mimic diagram and symbols 1 No.
iii) Multifunction Panel Meter: 1 No.
iv) Energy Meter (AC HT Static Trivector Meter TOD Type, Class 0.2s) Nil
v) IEC-61850 Compliant Bay Control Unit: (having all functions such as control, supervisory, monitoring, measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities/satisfactory operation of substation) 1 No.
vi) Trip circuit supervision relays suitable for both open and closed position of circuit breakers. 6 Nos.

vii) Three position locking pattern control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of breaker with i) Close, ii) Normal & iii) Trip position. 1 No.

viii) Three position control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of Isolator with i) Close, ii) Neutral & iii) Open position. 4 Nos.

ix) Automatic semaphore indicator for circuit breaker, Isolator and Earth switches. 1 Set

x) 24/36 way facia Annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized. Combination of both can also be utilized by selecting the lower size Annunciator scheme to meet the functionalities). 1 No.

xi) Three phase 4 wire link type test terminal block of current rating 15 amp for testing of trivector meters. 1 Set

xii) Two position locking pattern switch stay put type with pistol grip handle for trip transfer. i) Trip transfer ii) Normal 1 No.

xiii) Indicating LEDs for Breaker Position, Auto Trip & Healthiness 1 Set

xiv) Terminal Blocks 1 Set

xv) Auxiliary relay, CMR etc as required by the Scheme 1 LOT

xvi) Other general equipments/features as per general specification of simplex panels.

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Item No. 9 - 220 kV FEEDER RELAY PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-FRB’
-----------------------------------------------------------------------------------------------------------------------

i) Circuit identification label: 1 No.

ii) IEC-61850 Compliant Bay Protection Unit (Main Protection As per clause No. 9.5) [MAIN-I] 1 No.

iii) IEC-61850 Compliant Bay Protection Unit (Main Protection As per clause No. 9.5) [MAIN-II] 1 No.

iv) High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme. 2 Set.

v) IEC Compliant BPU (Back Up Protection as per clause 9.5.8.2 of specification)
vi) Voltage Selector Relay [if applicable] 1 Set
vii) IEC 61850 Compliant LBB [Separate as per Clause 9.6.2] 1 Set
   viii) IEC-61850 Compliant Circuit Breaker Protection [As per Clause 9.6.1]] 1 Set
       [with Check Synchronization Relay, Auto Re-close functions]
ix) DR, Fault Locator [Acceptable In Built Features of Main-I & II] 1 Set
ix) Lamp for DC fail Indication 1 No.
x) Push Button for DC fail accept 1 No.
xi) Flag relays, Carrier Receive Relay, auxiliary relay, CMR, timers etc as required by the Scheme 1 LOT
xii) DC Supervision Relay 1 Set
xiii) Under voltage Relay for Isolator/Earth Switch 2 Nos.
xiv) Overvoltage Protection Scheme 1 Set (Stage-I & II are acceptable as Inbuilt feature of Main-I & II respectively)
xv) Test Blocks for relays 1 Set
xvi) Carrier In/Out Switches/ Lamps as required by the Scheme 1 Set
xvii) Other general equipments/features as per general specification of simplex panels.

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Item No. 10 – 220 kV BUS COUPLER CONTROL/ TBC PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-BCCB’ /‘SAS-BTCB’
-----------------------------------------------------------------------------------------------------------------------
i) Circuit identification label: 1 No.
ii) Mimic diagram and symbols. 1 No.
iii) Multifunction Panel Meter: 1 No.
iv) Energy Meter (AC HT Static Trivector Meter TOD Type, Class 0.5s): Nil
v) IEC-61850 Compliant Bay Control Unit: 1 No. (having all functions such as control, supervisory, monitoring, measuring, synchro-check, interlock, pole discrepancy etc. for meeting the functionalities/ satisfactory operation of substation)
vi) Trip circuit supervision relays suitable for both open and closed position of circuit breakers. 6 Nos.

vii) Three position locking pattern control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of breaker with i) Close, ii) Normal & iii) Trip position. 1 No.

viii) Three position control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of Bay and Bus CVT Isolators 4 Nos.
with i) Close, ii) Normal & iii) Open position

ix) Automatic semaphore indicator for circuit breaker, isolator and earth switches.
x) 24/36 way facia Annunciator scheme complete with auxiliary relays and control switches as per specification with hooter & bell
   (If LED indications of BCU are insufficient to indicate the required annunciations the annunciation scheme shall be utilized.
   Combination of both can also be utilized by selecting the lower size Annunciator scheme to meet the functionalities).

xi) Three phase 4 wire link type test terminal block of current rating 15 amp for testing of trivector meters.
xii) Dead Bus Closing switch, Synchronization selector switch
     [If it is not achieved through the Soft Logics/BCU)

xiii) Indicating LEDs for Breaker Position, Auto Trip & Healthiness

xiv) Terminal Blocks

xv) Auxiliary relay, CMR etc as required

xvi) Other general equipments/features as per general specification of simplex panels.

Item No. 11 – 220 kV BUS COUPLER / TBC RELAY PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-BCRB’ / ‘SAS-BTRB’

i) Circuit identification label: 1 No.

ii) IEC-61850 Compliant Bay Protection Unit (As per clause No. 9.8) 1 No.

ii) IEC-61850 Compliant Circuit Breaker Protection [As per Clause 9.6.1] 1 Set

iii) High speed trip relay (1 phase & 3 Phase trip unit) with adequate number of contacts for the complete scheme. 1 Set

iv) Voltage Selector Relay [if applicable] 1 Set

v) IEC 61850 Compliant LBB [Separate as per Clause 9.6.2] 1 Set

vi) Lamp for DC fail Indication 1 No.

vii) Push Button for DC fail accept 1 No.

viii) Auxiliary relay, CMR, timers etc as required by the Scheme. 1 LOT

ix) DC Supervision Relay 1 Set

x) Test Blocks for relays 1 Set

xi) Flag relays, auxiliary relay, CMR, timers etc as required by the Scheme 1 LOT

xiii) Other general equipments/features as per general specification of simplex panels.

Item No. 12 – 220 kV BUSBAR PROTECTION RELAY PANELS:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-BBBR’
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Circuit identification label: 1 No.</td>
</tr>
<tr>
<td>ii)</td>
<td>IEC-61850 Compliant Master/ Main (BB Protection As per clause No. 9.7) 1 No.</td>
</tr>
<tr>
<td>iii)</td>
<td>Peripheral unit &amp; central unit (for 9 Bays + 1 future bays) 10 Nos.</td>
</tr>
<tr>
<td>vi)</td>
<td>Bus Zone In/Out Switches 1 Set</td>
</tr>
<tr>
<td>vii)</td>
<td>12 way Annunciator 1 Set</td>
</tr>
<tr>
<td>viii)</td>
<td>DC selection switch 1 Set</td>
</tr>
<tr>
<td>ix)</td>
<td>Lamp for DC fail Indication 1 No.</td>
</tr>
<tr>
<td>x)</td>
<td>Push Button for DC fail accept 1 No.</td>
</tr>
<tr>
<td>xi)</td>
<td>Auxiliary relay, CMR, etc as required by the Scheme. 1 LOT</td>
</tr>
<tr>
<td>xv)</td>
<td>DC Supervision Relay 1 Set</td>
</tr>
<tr>
<td>xvi)</td>
<td>Test Blocks for relays 1 Set</td>
</tr>
<tr>
<td>xvii)</td>
<td>Other general equipments/features as per general specification of simplex panels.</td>
</tr>
</tbody>
</table>

---

**Item No. 13 - 33 kV CONTROL AND RELAY PANELS [ FOR TWIN FEEDER/ BAY]:**

Simplex panels as required equipped with the following and fully wired:

**PANEL DESIGNATION: PANEL ‘SAS-FCRD’**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Circuit identification label 1 No.</td>
</tr>
<tr>
<td>ii)</td>
<td>Mimic diagram and symbols 1 No.</td>
</tr>
<tr>
<td>iii)</td>
<td>Multifunction Panel Meter: 2 Nos.</td>
</tr>
<tr>
<td>iv)</td>
<td>Energy Meter (AC HT Static Trivector Meter TOD Type Class 0.2s for transformer incomers and Class 0.5 s for others) Nil.</td>
</tr>
<tr>
<td>v)</td>
<td>IEC-61850 Compliant Bay Control Protection Unit: 2 Nos. (having all functions such as control, supervisory, monitoring, measuring, interlock, Over current &amp; earth fault protection etc. for meeting the functionalities/ satisfactory operation of substation)</td>
</tr>
<tr>
<td>vi)</td>
<td>Trip circuit supervision relays for continuous supervision 2 Set.</td>
</tr>
<tr>
<td>vii)</td>
<td>High speed trip relay (3 Phase trip unit) with adequate number of contacts for the complete scheme. 2 Set.</td>
</tr>
<tr>
<td>viii)</td>
<td>Voltage Selector Relay [if required] 1 Set</td>
</tr>
<tr>
<td>ix)</td>
<td>Lamp for DC fail Indication 1 Set.</td>
</tr>
<tr>
<td>x)</td>
<td>Push Button for DC fail accept 1 Set.</td>
</tr>
<tr>
<td>xi)</td>
<td>Flag relays, auxiliary relay, CMR, timers etc as required by the Scheme. 1 LOT</td>
</tr>
<tr>
<td>xii)</td>
<td>DC Supervision Relay 1 Set</td>
</tr>
<tr>
<td>xiii)</td>
<td>Test Blocks for relays 1 Set</td>
</tr>
<tr>
<td>xiv)</td>
<td>Three position locking pattern control switch with spring return to normal and having of contact with lost motion device and two sets of contacts which shall remain in neutral after close position with pistol grip handle for control of breaker with i) Close , ii)Normal &amp; iii) Trip position. 1 No.</td>
</tr>
<tr>
<td>xv)</td>
<td>Automatic semaphore indicator for circuit breaker , Isolator and Earth switches. 1 Set</td>
</tr>
</tbody>
</table>
xvi) Other general equipments/features as per general specification of simplex panels.

Item No. 14- SUBSTATION AUTOMATION SYSTEM NETWORK PANEL:
Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-NW’

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Circuit identification label:</td>
<td>1 No.</td>
</tr>
<tr>
<td>2)</td>
<td>Main Industrial Computer/ Server (Rack Mountable Fitting)</td>
<td>1 No.</td>
</tr>
<tr>
<td>3)</td>
<td>Hot Standby Industrial Computer /Server (Rack Mountable Fitting)</td>
<td>1 No.</td>
</tr>
<tr>
<td>4)</td>
<td>Managed Ethernet Switches 24 Ports</td>
<td>2 Sets</td>
</tr>
<tr>
<td></td>
<td>(Suitable with Substation DC Supply)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td>LIU / Jack Panels (Rack Mountable)</td>
<td>1 LOT</td>
</tr>
<tr>
<td>6)</td>
<td>SC Adapter &amp; Pigtails</td>
<td>1 LOT</td>
</tr>
<tr>
<td>7)</td>
<td>1 mtr Fiber Patch Cord</td>
<td>1 LOT</td>
</tr>
<tr>
<td>8)</td>
<td>Lamp for DC fail Indication</td>
<td>1 No.</td>
</tr>
<tr>
<td>9)</td>
<td>Push Button for DC fail accept</td>
<td>1 No.</td>
</tr>
<tr>
<td>10)</td>
<td>DC Supervision Relay</td>
<td>1 Set</td>
</tr>
<tr>
<td>11)</td>
<td>Other general equipments/features as per general specification of simplex panels</td>
<td></td>
</tr>
</tbody>
</table>

Item No. 15 - SUBSTATION NETWORK PANEL:

Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-FN’

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Circuit identification label:</td>
<td>1 No.</td>
</tr>
<tr>
<td>2)</td>
<td>24 Port (as per requirement + 4 Spare) Managed Ethernet Switch</td>
<td>1 Set</td>
</tr>
<tr>
<td></td>
<td>(Suitable with Substation DC Supply)</td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td>LIU (Rack Mountable)</td>
<td>1 LOT</td>
</tr>
<tr>
<td>4)</td>
<td>SC Adapter &amp; Pigtails</td>
<td>1 LOT</td>
</tr>
<tr>
<td>5)</td>
<td>1 mtr Fiber Patch Cord</td>
<td>1 LOT</td>
</tr>
<tr>
<td>6)</td>
<td>Lamp for DC fail Indication</td>
<td>1 No.</td>
</tr>
<tr>
<td>7)</td>
<td>Push Button for DC fail accept</td>
<td>1 No.</td>
</tr>
<tr>
<td>8)</td>
<td>DC Supervision Relay</td>
<td>1 Set</td>
</tr>
<tr>
<td>9)</td>
<td>Other general equipments/features as per general specification of simplex panels</td>
<td></td>
</tr>
</tbody>
</table>

Item No. 16 - TIME SYNCHRONIZATION AND GATEWAY PANEL:

Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-TSE/GW’

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Circuit identification label:</td>
<td>1 No.</td>
</tr>
<tr>
<td>2)</td>
<td>Time Synchronization Equipment (TSE)</td>
<td>1 No.</td>
</tr>
<tr>
<td>3)</td>
<td>Master Display Unit (LED) 100 mm Size</td>
<td></td>
</tr>
</tbody>
</table>
(to be synchronized from TSE)

iv) Gateways to RCC & SLDC (Fitting only) 1 Set
v) Modems (Fitting only) 1 Set
vi) Lamp for DC fail Indication 1 No.
vii) Push Button for DC fail accept 1 No.
viii) DC Supervision Relay 1 Set
ix) Other general equipments/features as per general specification of simplex panels

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Item No. 17 – SUBSTATION AUXILIARY MONITORING PANEL:

Simplex panels as required equipped with the following and fully wired:

PANEL DESIGNATION PANEL ‘SAS-SAMP’

-----------------------------------------------------------------------------------------------------------------------
i) Circuit identification label: 1 No.
ii) IEC-61850 Compliant Bay Control Unit 1 No.
(having all functions such as control, supervisory, monitoring, Measuring of all the
LT Transformers, LT AC/DC Supplies, Fire Fighting, Air-Conditioning, Automatic
Supply Changeovers DG Set, Ambient Temperatures, Battery System, PLCC Panels
Counters etc. for meeting the functionalities/ satisfactory auxiliary operation of
substation)

[BCU shall be equipped with sufficient Analog, Digital input/ output Cards
alongwith communication ports/ Protocols such as Modubus RTU etc. for
interfacing transducers and further interface on Substation SCADA on IEC-
61850 to transfer of events/ alarms and other measured parameters for
monitoring]

iii) 24/36 way facia Annunciator scheme complete with auxiliary relays and control switches as per
specification with hooter & bell

iv) Auxiliary relay, CMR etc as required 1 LOT
by the Scheme
v) Other general equipments/features as per general specification of simplex panels.

-----------------------------------------------------------------------------------------------------------------------

GENERAL NOTE:

1. The panels are optimized in view of the space limitations in Control Room. It is assumed that,
   various functionalities/ items (except those required mandatorily external to BCU/BPU or as per
   protection requirement in separate device) already integrated/in-built in modern BCU/BPU shall
   be put to fullest use so as to reduce the panel requirements.

2. APPROVED MAKE AND MODEL OF RELAYS:

3.1 The following approved makes & models of Numerical relays are only acceptable for
Distance, Over Current & Earth fault and LBB protections:

<table>
<thead>
<tr>
<th>Distance Relay for 220kV Feeder C&amp;R Panel</th>
<th>Combined Over Current &amp; Earth Fault relay and separate LBB relay for 220kV C&amp;R Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAKE</td>
<td>MODEL</td>
</tr>
</tbody>
</table>

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Subject to confirmation that the relay supplied shall be suitable for both 1A & 5A. However, the conversion from 1A to 5A and vice versa with ICT is also acceptable.

RSDCL would like to have Differential protection on certain 220kV feeders for which Differential Relay (Numerical) is to be provided in C&R Panels in place of ‘Distance Relay’ (Numerical). The Differential Relay shall have the features, provisions & compatibility as described in the specification of 220kV Trf. C&R Panel. The acceptable Make and Model of the Differential Relay to be provided in these panels shall be as under:

<table>
<thead>
<tr>
<th>MAKE</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>RET670</td>
</tr>
<tr>
<td>ABB</td>
<td>REF 615</td>
</tr>
<tr>
<td>AREVA</td>
<td>MICOM P442, MICOM P444</td>
</tr>
<tr>
<td>AREVA</td>
<td>MICOM P141</td>
</tr>
<tr>
<td>SIFANG</td>
<td>CSC101 (For 132kV Panel only)</td>
</tr>
<tr>
<td>SIFANG</td>
<td>CSC162</td>
</tr>
<tr>
<td>SEL</td>
<td>SEL 311C (For 132kV Panel only)</td>
</tr>
<tr>
<td>SEL</td>
<td>SEL 751 (For O/C + E/F Protection), SEL 751A</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>7SA522</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>S7J62, S7J80, S7J61 (For LBB Protection)</td>
</tr>
</tbody>
</table>

Subject to confirmation that the relay supplied shall be suitable for both 1A & 5A. However, the conversion from 1A to 5A and vice versa with ICT is also acceptable.

4. **APPROVED MAKE AND MODEL OF RELAYS:**

4.1 The following approved makes & models of Numerical relays are only acceptable for Differential, Over current & Earth fault and LBB protection:

<table>
<thead>
<tr>
<th>Differential Relay for 220 kV Feeder C&amp;R Panel</th>
<th>Combined Over Current &amp; Earth Fault relay and separate LBB relay (For 220 kV C&amp;R Panel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAKE</td>
<td>MODEL</td>
</tr>
<tr>
<td>ABB</td>
<td>RET670</td>
</tr>
<tr>
<td>ABB</td>
<td>REF 615</td>
</tr>
<tr>
<td>ALSTOM/SCHNEIDER</td>
<td>MICOM P642, MICOM P643</td>
</tr>
<tr>
<td>SIFANG</td>
<td>CSC326</td>
</tr>
<tr>
<td>SIFANG</td>
<td>CSC326</td>
</tr>
<tr>
<td>SEL</td>
<td>SEL 787 (For 132 kV Transformer Panel only)</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>7UT613 (With 8Nos. Binary Input &amp; 8Nos. Binary Output contacts)</td>
</tr>
</tbody>
</table>

Subject to confirmation that the relay supplied shall be suitable for both 1A & 5A. Conversions from 1A to 5A and vice versa with ICT are also acceptable.
(c) For auxiliary and other relays (except main, Back up and LBB protection relays), in case, make of relays are other than following then type test reports of such relays shall also be furnished:

(i) Alstom (formerly Areva)
(ii) ABB
(iii) EasunReyrolle

In case, make of auxiliary and other relays (except main, Back up and LBB protection relays) are other than the approved relays then the bidder shall furnish the following valid and authenticated Type test certificates/reports from the manufacturer/a Govt./a Govt. approved/ a Govt. recognized/ NABL accredited laboratory/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) as per latest edition of IS-3231 or IEC of quoted relays or on model having additional features in same series. Such type test certificate should not be older than 7 years as on the date of technical bid opening. For this purpose, date of conducting type test will be considered.

(i) Insulation test.
(ii) High frequency disturbance test (not applicable for electromechanical relays).
(iii) Electrical fast transient test (not applicable for electromechanical relays).
(iv) Relay characteristics, performance and accuracy test.
   (a) Steady state characteristics and operating time.
(v) Test for thermal requirement.
(vi) Test for mechanical requirement.
(vii) Test for rated burden.
(viii) Contact performance test.

(d) In case of all type of 220kV C&R panels, the bidder shall furnish an undertaking that the panels shall provide minimum degree of enclosure protection equivalent to IP 31 in accordance with IS 13947 (Part-1).

4.2 The following make of bought out items are acceptable to RSDCL for all 220kV C&R Panels:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of item</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Indicating Instrument (Analogue type)</td>
<td>AE/IMP/MECO/Rishabh</td>
</tr>
<tr>
<td>2.</td>
<td>Digital multifunction meter (Digital type)</td>
<td>SATEC (For other make refer foot note below)</td>
</tr>
<tr>
<td>3.</td>
<td>Control Switch for Circuit Breaker/Trip Transfer</td>
<td>ALSTOM(Areva)/SWITRON/KAYCEE/ABB/RECOM/ Easun Reyrolle</td>
</tr>
<tr>
<td>4.</td>
<td>Selector Switch for Voltmeter/ Ammeter</td>
<td>SWITRON/KAYCEE/RECOM</td>
</tr>
<tr>
<td>5.</td>
<td>Semaphore Indicator</td>
<td>ALSTOM(Areva)/DAV(DEEPL)/ER</td>
</tr>
<tr>
<td>6.</td>
<td>Indicating Lamp(LED Type)</td>
<td>ALSTOM(Areva)/TEKNIC/VAISHNO/DAV(DEEPL)/ VENSON /L&amp;T/SIEMENS</td>
</tr>
<tr>
<td>7.</td>
<td>Annunciator</td>
<td>MINILEC/YASHMUN/INSTALRAM/PROTON/JVS/ALAN /PRADEEP/EXPO FYN</td>
</tr>
<tr>
<td>8.</td>
<td>Push Button</td>
<td>TEKNIC/VAISHNO/ESSEN/L&amp;T/SIEMENS/ALSTOM (Areva)</td>
</tr>
<tr>
<td>9.</td>
<td>A.C. Hooter/Bell</td>
<td>TARGET/INDUSTRIAL HOOTER/ALAN/JVS</td>
</tr>
<tr>
<td>10.</td>
<td>D.C. Hooter / Bell</td>
<td>TARGET/INDUSTRIAL HOOTER/ALAN/JVS</td>
</tr>
<tr>
<td>11.</td>
<td>Heater</td>
<td>SOFIA/ELTER/AIREX/ KAYCEE /PRAVEEN</td>
</tr>
<tr>
<td>12.</td>
<td>Link type Test Terminal Block for testing of TVM</td>
<td>IMP/CAPITAL/DAV</td>
</tr>
<tr>
<td>13.</td>
<td>2 Feet Tube Light</td>
<td>PHILIPS/CROMPTON/BAJAJ</td>
</tr>
</tbody>
</table>
14. 2 Pin/3 Pin socket with switch (5/15A)  ISI MARK

NOTE: In case, the successful bidder establish es to the Satisfaction of purchaser that the specified makes of particular item (except digital multifunctional meter) are not available th en other make shall also be acceptable, if it is of “ISI” MARK or type tested for which bidder shall furnish attested Photostat copies of valid ISI certificate/type test reports. The type test report s should not be older than 7 years as on the date of Technical bid opening. As regard digital multifunction meter, the other make is also acceptable, provided it meets the requirement of specification.

4.4 MAKE AND TYPE OF BOUGHT OUT ITEMS:

The make/type of each relay, indicating instruments, integrating instruments, Control switches, selector switches, indicating lamps, Semaphore indicators, Annunciation scheme, Bell, Hooter etc shall be clearly and invariably indicated in the GTP (Guaranteed Technical Particulars), Bill of material. Only specific make accessories shall be indicated. The words like “EQUIVALENT/ REPUTED MAKE” will not be given consideration.

5. DOCUMENTATION

Two sets of following documents shall be supplied to the consignee for field officer s alongwith each panel and one sets to the purchaser:

(i) Approved drawings after making corrections as advised at the time of approval of drawings.
(ii) The complete technical literature, commissioning/operating/maintenance instruction manuals of protection scheme (s)/relay /relay testing instruments/integrating instruments/etc.

6. DEMONSTRATION AND TESTING OF OFFERED RELAYS/ INSTRUMENTS/ ACCESSORIES

RSDCL reserves the right to get demonstration and sample testing of offered protection scheme(s) /relay(s)/instruments/accessories to ascertain their technical suitability, in any Govt./NABL approved lab or in RVPNL test lab at the risk & Cost of supplier/contractor.

7. Acceptable Make and Model of Relays (only for performance purpose):

(a) The following makes & models of Numerical relays are only acceptable for main Over current & Earth fault protection:

<table>
<thead>
<tr>
<th>FOR 33 KV C&amp;R PANELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
</tr>
<tr>
<td>ABB</td>
</tr>
<tr>
<td>AREVA</td>
</tr>
<tr>
<td>SEL</td>
</tr>
<tr>
<td>SIEMENS</td>
</tr>
<tr>
<td>ER</td>
</tr>
<tr>
<td>SIFANG</td>
</tr>
</tbody>
</table>

Subject to confirmation that the relay supplied shall be suitable for both 1A & 5A. Conversion from 1A to 5A and vice versa with ICT is acceptable.

In case, the bidder wants to quote other than the acceptable models of relays, then prior to quoting that relay, they shall have to get approved the same from the Director (Technical), RSDCL, Jaipur by submitting its type test reports and arranging demonstration for ascertaining that the relay to be offered meets the requirement of specification.
Alternatively, bidder may get the relay approved from the Director (Technical), RSDCL, Jaipur by conducting demonstration in NABL approved lab or in RVPN laboratory/site, get the certificate of approval from NABL approved lab or from the Chief Engineer (MPT&S) RVPN, Jaipur and submit the same to RSDCL for approval. For the panels supplied with such relays, the performance guarantee period shall be double the period specified in the specification (i.e. in such cases performance guarantee period shall be 60 months from the date of commissioning or 72 months from the date of supply of last consignment at site whichever is earlier).

(b) For auxiliary and other relays, except main protection, in case make of relays are other than following then type test report of such relays shall also be furnished:

(i) Areva (formerly Alstom, Now GE T&D).
(ii) ABB.
(iii) Easun Reyrolle.
(iv) JVS.

In case, the make of auxiliary and other relays, except main protection, are other than the approved then the bidder shall furnish the following valid and authenticated Type test certificate from NABL accredited laboratory/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) as per latest edition of IS-3231 or IEC of quoted relays or on model having additional features in same series. Such type test certificate should not be older than 7 years as on the date of technical bid opening. For this purpose, date of conducting type test will be considered.

(i) Insulation test.
(ii) High frequency disturbance test (not applicable for electromechanical relays).
(iii) Electrical fast transient test (not applicable for electromechanical relays).
(iv) Relay characteristics, performance and accuracy test.
   (a) Steady state characteristics and operating time.
   (b) Dynamic characteristics and operating time for distance relay.
(v) Test for thermal requirement.
(vi) Test for mechanical requirement.
(vii) Test for rated burden.
(viii) Contact performance test.

(c) In case of 33KV C&R panels, which are simplex type, the bidder shall have to furnish test report for degree of protection on enclosure as IP-31 in accordance with IS-13947 (Part-I) from NABL accredited/Govt./Govt. approved lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) on C&R panel of any size. In case of relay manufacturer, type test reports furnished in the name of panel fabricator shall also be acceptable, provided the firm confirms to supply panels of same fabricator.

8. The following make of bought out items are acceptable to RSDCL for the purpose of functionalities of 33kV Panels:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of item</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital multifunction meter</td>
<td>SATEC</td>
</tr>
<tr>
<td>2</td>
<td>Control Switch for Circuit Breaker/ Trip Transfer</td>
<td>ALSTOM (Areva)/SWITRON/KAYCEE/ ABB/ RECOM/Easun Reyrolle</td>
</tr>
<tr>
<td>3</td>
<td>Selector Switch for Voltmeter / Ammeter</td>
<td>SWITRON/KAYCEE/RECOM</td>
</tr>
<tr>
<td>4</td>
<td>Semaphore Indicator</td>
<td>ALSTOM (Areva)/DAV/(DEEPL)/ER</td>
</tr>
<tr>
<td>5</td>
<td>Indicating Lamp (LED Type)</td>
<td>ALSTOM (Areva)/TEKNIC /VAISHNO /DAV (DEEPL) / VENSON/L&amp;T/Siemens/JVS</td>
</tr>
<tr>
<td>6</td>
<td>Annunciator</td>
<td>MINILEC/YASHMUN/INSTALRAM/PROTON/</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Supplier</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>Push Button</td>
<td>TEKNIC/VAISHNO/ESSEN/L&amp;T/Siemens/Alstom (Areva)</td>
</tr>
<tr>
<td>8</td>
<td>A.C. Hooter/Bell</td>
<td>TARGET/INDUSTRIAL HOOTER/ALAN/JVS</td>
</tr>
<tr>
<td>9</td>
<td>D.C. Hooter / Bell</td>
<td>TARGET/INDUSTRIAL HOOTER/ALAN/JVS</td>
</tr>
<tr>
<td>10</td>
<td>Heater</td>
<td>SOFIA/ELTER/AIREX/ KAYCEE /Praveen</td>
</tr>
<tr>
<td>11</td>
<td>Link type test terminal block for testing of TVM</td>
<td>IMP/CAPITAL/ DAV Industries</td>
</tr>
<tr>
<td>12</td>
<td>2 FEET LED TUBE LIGHT</td>
<td>PHILIPS/CROMPTON/BAJAJ</td>
</tr>
<tr>
<td>13</td>
<td>2 Pin/3 Pin socket with switch (5A/15A)</td>
<td>ISI MARK</td>
</tr>
<tr>
<td>14</td>
<td>0.2S Class AC Static HT-TVM TOD (ABT) type Energy Meter</td>
<td>L&amp;T/Secure/Genus/Wallby</td>
</tr>
</tbody>
</table>

**NOTE:** In case, the successful bidder establish to the satisfaction of purchaser that the specified makes of particular item (except digital multifunctional meter) are not available then other make shall also be acceptable, if it is of valid "ISI MARK" or type tested for which bidders shall furnish attested Photostat copies of ISI certificate/type test reports. The type test reports should not older than 7 years as on date of technical bid opening. As regard digital multifunction meter, the other make is also acceptable, provided it meets the requirement of specification.

**8.1 MAKE AND TYPE OF BOUGHT OUT ITEMS:**

Make/type of each relay, integrating instruments, Control switches, selector switches, indicating lamps, Semaphore indicators, Annunciator scheme, Bell, Hooter etc. shall be clearly and invariably indicated in the GTP (Guaranteed Technical Particulars), Bill of material. Only specific make accessories shall be indicated. The Word “EQUIVALENT/ REPUTED MAKE” will not be given consideration.

**9. GUARANTEE PERIOD OF CONTROL AND RELAY PANELS:**

The guarantee period of all type & voltage class “Control & Relay” panels (including Relays) shall be 30 Months from the date of commissioning or 36 Months from the date of receipt of last consignment at site, whichever is earlier.
1. **LINE PARAMETERS**

   **A. LINE CONSTANTS OF 220 KV LINE (P.U. POSITIVE SEQUENCE VALUES PER KM)**

   (I) **BASE 100 MVA**

<table>
<thead>
<tr>
<th>CONDUCTOR</th>
<th>SECTIONAL AREA TOTAL</th>
<th>SECTIONAL AREA ALUM.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE ZEBRA</td>
<td>428.9 SQ.MM</td>
<td>428.9 MM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>X1</th>
<th>B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE CIRCUIT</td>
<td>.00016</td>
<td>.00025</td>
<td>.00132</td>
</tr>
<tr>
<td>DOUBLE CIRCUIT</td>
<td>.00008</td>
<td>.000425</td>
<td>.00264</td>
</tr>
</tbody>
</table>

2. **PROPOSED TRANSFORMER CAPACITIES AT EACH STATION**

   | 220 KV CLASS | 100 MVA, 220 / 33 KV |
   | 33 KV CLASS  | 250 KVA, 33/.4 KV (Station Transformer) |

   i) **BCT:** As specified in Power Transformer specification

3. **TECHNICAL PARTICULARS OF CTS PROPOSED TO BE UTILISED AT VARIOUS POOLING STATIONS**

   i. **220 KV TRANSFORMER CT FOR HV SIDE OF 220/33 KV TRANSFORMER**

   RATIO : 500 – 1000/-1-1-1-1-1A

<table>
<thead>
<tr>
<th>No.of Cores</th>
<th>Core No.</th>
<th>Application</th>
<th>Rated burden</th>
<th>Class of Accuracy</th>
<th>Max. Instrument Security Factor</th>
<th>Min. Knee point voltage at 75 Deg.C at lowest tap</th>
<th>Max. Sec. winding resistance at 75 Deg. C at lowest ratio (Ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>Main protection-I</td>
<td>--</td>
<td>PS</td>
<td>_</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Main protection-II</td>
<td>--</td>
<td>PS</td>
<td>_</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Metering</td>
<td>10VA</td>
<td>0.2s</td>
<td>5</td>
<td>_</td>
<td>_</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Protection</td>
<td>--</td>
<td>PS</td>
<td>--</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Bus Bar Check</td>
<td>--</td>
<td>PS</td>
<td>----</td>
<td>850 V</td>
<td>2.50</td>
</tr>
</tbody>
</table>

   ii. **220 KV FEEDER & BUS COUPLER CT RATIO : 500 – 1000/-1A 5C**

<table>
<thead>
<tr>
<th>No.of Cores</th>
<th>Core No.</th>
<th>Application</th>
<th>Rated burden</th>
<th>Class of Accuracy</th>
<th>Max. Instrument Security Factor</th>
<th>Min. Knee point voltage at</th>
<th>Max. Sec. winding resistance at</th>
</tr>
</thead>
</table>

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### iii. 33 kV I/C of TRANSFORMER, BUS COUPLER & SECTIONLISER CT:
RATIO: 2400 / (1A) 4C

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Application</th>
<th>Rated Burden</th>
<th>Class of Accuracy</th>
<th>Factor</th>
<th>75 Deg. C at lowest ratio</th>
<th>75 Deg. C at lowest tap (Ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Differential Protection</td>
<td>--</td>
<td>PS</td>
<td>_</td>
<td>850 V</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>Back Up Protection</td>
<td>40 VA</td>
<td>PS</td>
<td>_</td>
<td>850 V</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>Protection</td>
<td>---</td>
<td>PS</td>
<td>_</td>
<td>850 V</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>Metering</td>
<td>10 VA</td>
<td>0.2s</td>
<td>5</td>
<td>_</td>
<td>_</td>
</tr>
</tbody>
</table>

### iv. 33 KV FEEDER CT RATIO: 500-1000 / (1A) 2C

<table>
<thead>
<tr>
<th>No. of cores</th>
<th>Core No.</th>
<th>Application</th>
<th>Rated Burden</th>
<th>Class of accuracy</th>
<th>Maximum instrument security factor</th>
<th>Minimum Knee Point Voltage at lowest Tap</th>
<th>Maximum Secondary Winding resistance at 75 Deg. C. at lowest Tap</th>
<th>Max. accuracy limit factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>PROTECTION</td>
<td>-</td>
<td>PS</td>
<td>_</td>
<td>650V</td>
<td>2.5</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>METERING</td>
<td>10 VA</td>
<td>0.2s</td>
<td>5</td>
<td>_</td>
<td>_</td>
<td>---</td>
</tr>
</tbody>
</table>
ANNEXURE –V2-P3-S1-3

GENERAL ANNUNCIATION WINDOW/ LED CONFIGURATION REQUIREMENTS

1. **220/33 KV TRANSFORMERS (220 KV SIDE):**

TRIP ALARMS FACIA INDICATIONS:

   i) Main Differential Prot. operated  
   ii) Circulating Current Differential Prot. operated  
   iii) Overcurrent prot. operated.  
   iv) Earth Fault prot. operated.  
   v) Restricted Earth Fault prot. operated.  
   vi) Neutral displacement prot. operated.  
   vii) Over flux prot. trip.  
   viii) LBB prot. operated.  
   ix) Buchholz Alarm-I.  
   x) Buchholz Alarm-II.  
   xi) Buchholz Trip-I.  
   xii) Buchholz Trip-II.  
   xiii) Pressure Relief Device-I/II operated.  
   xiv) HV/LV Winding Temperature Trip.  
   xv) Oil Temperature Trip.  
   xvi) OLTC Surge Relay Trip U-phase.  
   xvii) OLTC Surge Relay Trip V-phase.  
   xviii) OLTC Surge Relay Trip W-phase.  
   xix) OLTC Surge Relay Trip Common.  
   xx) Bus Bar Protection Trip Relay Operated.

NON TRIP ALARMS FACIA INDICATIONS(220 KV TR.)

   i) HV/LV Winding Temperature High.  
   ii) Oil Temperature Trip.  
   iii) Over flux prot. Alarm.  
   iv) Transformer Oil Level Low.  
   v) OLTC Oil Level Low.  
   vi) Group A/B protection DC Fail.  
   vii) VT not selected.  
   ix) CB Trip Circuit-1 Faulty.  
   x) CB Trip Circuit-2 Faulty.  
   xi) CB Low Air Pressure.  
   xii) CB Low SF 6 Gas Pressure.  
   xiii) CB Low Air/SF 6 Gas Pressure Lockout.  
   xiv) CB Pole Discrepancy Trip.  
   xv) Control Board AC Supply Fail.

2. **245 KV REACTOR: TRIP ALARMS FACIA INDICATIONS:**
i) Main Differential Prot. operated
ii) Circulating Current Differential Prot. operated
iii) Overcurrent prot.operated.
iv) Earth Fault prot. operated.
v) Restricted Earth Fault prot. operated.
vi) Neutral displacement prot. operated.
vii) Over flux prot. trip.
viii) LBB prot. operated.
ix) Buchholz Alarm-I.
x) Buchholz Alarm-II.
xi) Buchholz Trip-I.
xii) Buchholz Trip-II.
xiii) Pressure Relief Device-I/II operated.
xiv) Winding Temperature Trip.
xx) Bus Bar Protection Trip Relay Operated.

NON TRIP ALARMS FACIA INDICATIONS (245 KV reactor.)

i) Winding Temperature High.
ii) Oil Temperature Trip.
iii) Over flux prot. Alarm.
iv) Reactor Oil Level Low.
vii) VT not selected.
ix) CB Trip Circuit-1 Faulty.
x) CB Trip Circuit-2 Faulty.
xii) CB Low Air Pressure.
xii) CB Low SF 6 Gas Pressure.
xiii) CB Low Air/SF 6 Gas Pressure Lockout.
xiv) CB Pole Discrepancy Trip.
xv) Control Board AC Supply Fail.

3. **220 kV LINE PANEL:**

TRIP ALARMS:

1. Distance protection operated.
2. Auto re-close lockout.
3. Pole discrepancy relay operated.
4. DOCR/DEFR operated.
5. Bus bar protection operated,
6. Local breaker back up protection operated,

NON - TRIP ALARMS

1. Trip circuit supervision alarm TC 1.
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm.
5. SF6 gas pressure low.
6. Air pressure low
7. DC fail to distance protection/ control circuit.
8. Breaker lockout.
9. Auto re-close operated.
10. Carrier receive.
11. Spare. two nos.

4. **220 kV BUS COUPLER:**

**TRIP ALARMS:**

1. Pole discrepancy relay operated.
2. Bus bar protection operated.
3. OCR/ EFR operated.
4. Local breaker back up protection operated.

**NON TRIP ALARMS:**

1. Trip circuit supervision alarm TC 1
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm,
5. SF6 gas pressure low.
6. Air pressure low.
7. DC fail to distance protection/ control circuit.
8. Breaker lockout.
9. Spare six nos.

5. **220 KV BUS BAR PROTECTION PANELS:**

**TRIP ALARM.**

1. Local breaker back up protection operated.
2. Bus bar protection operated.

**NON TRIP ALARM:**

1. CT Secondary open circuit.
2. Bus bar check operated.

6. **33 KV FEEDER:**

**TRIP ALARMS:**
1. OCR operated
2. EFR operated

NON TRIP ALARMS:
1. Trip circuit supervision alarm TC1.
2. Trip circuit supervision alarm TC2.
3. SF6 gas pressure low.
4. Air pressure low.
5. Breaker lockout.
7. DC fail.
SPECIFICATION FOR DESIGN, MANUFACTURING AND TESTING/COMMISSIONING OF 80/100 MVA, 220/33 KV POWER TRANSFORMER

1.01 SCOPE:

This specification covers the design, manufacture, stage inspection, testing at the manufacturer’s works before dispatch, supply and delivery at the RSDCL destination Pooling Sub-stations (4 Nos.) of Nokh (Jaisalmer) Solar Park in Rajasthan, unloading on foundation at site, (In case foundation is not ready, unloading on the place at site indicated by consignee) and supervision of commissioning of transformer(s). The scope also includes the supply (after due inspection), erection, testing & commissioning of Nitrogen Injection Fire Prevention & Extinguishing System as mentioned in the tender specification.

1.02 CLIMATIC CONDITIONS: As mentioned above at Clause 3.0 of Section-I.

1.03 GENERAL REQUIREMENTS:

The intention of the specification is to provide information for the design of the above mentioned Power Transformers to be fully suitable in every respect for the functions designated. It is required that the supplier, in accepting the contract, agrees to furnish all apparatus, appliance and material whether specifically mentioned or not, but which may be found necessary to complete, perfect and test any of the units specified herein in compliance with the requirements implied in this specification without extra charges.

1.03.1: All terminal screws, studs, nuts and bolts shall be in accordance with the Indian Standards.

1.03.2: All electrical and mechanical equipment shall be designed and manufactured so that no damage will result from transportation, installation and operation of the equipment under the climatic conditions to which it will be subjected.

1.03.3: All materials used shall conform to this specification and appropriate standards and shall be new in all respects.

1.03.4: Consideration may be given to alternatives which the supplier considers advisable by reason of his own manufacturing requirements and experiences, provided descriptive matter is submitted and the recommended device or arrangement equal to, or superior to that required by the accompanying specification and if the purchaser is convinced of the quality and/or superiority of the equipment.

1.04: STANDARDS:

The Power Transformers, their accessories and fittings, transformer oil, etc. shall conform to the latest edition of the following standards (as amended upto date) except where specified otherwise in this specification:

1) Transformer. : IS-2026
2) On load tap changer. : IS-8468
3) Current Transformers. : IS-2705
4) Transformer oil. : IS-335
5) Gas & oil operated relays. : IS-3637
6) Fans. : IS-2312
7) Motors. : IS-325 & 996
8) Bushings. : IS-2099 & IS-3347
9) Fittings and accessories for power transformers. : IS-3639
10) Code of practice for selection : IS-10028
installation & maintenance of transformer.

11) Guide for loading of oil immersed transformers: IS-6600

12) Code of practice for installation & maintenance of transformers: IS-1886

13) Marking & arrangement for Switchgears, busbars, main connectors and auxiliary wiring: IS-5578 & IS-11353

14) Degree of protection provided by enclosures for low voltage switchgear & control gear: IS-2147

15) Colour for ready mix paint: IS-5

16) Power connectors: IS-5561

17) Potential Transformer: IS-3156

1.04.1: Equipment meeting the requirements of any other authoritative standards which ensures a quality equal to or better than that as per the standards mentioned above, shall also be acceptable. Where the equipment conforms to any other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the tender.

1.05: DEPARTURE FROM SPECIFICATION:

If the bidder/supplier wishes to depart from the specification in any respect, he should draw attention to such departures, stating the reasons thereof under Schedule-V. Unless this is done, the departmental specification will hold good. Mentioning of deviations in the form of clarifications etc. elsewhere in the offer will not be considered. In the event of this specification and contractor's drawings, specification, table etc. being found to disagree during the execution of the contract, the requirement of this specification shall be held as binding unless the departures have been duly approved in writing by the RSDCL.

1.06: TROPICAL TREATMENT:

Under the climatic conditions prevalent at the site, the equipment supplied under the specification will be subjected to operation under the ambient temperature specified at clause 1.02 above and very high relative humidity. All equipments shall, therefore be suitably designed and tested for normal life and satisfactory operation under the worst climatic conditions prevalent at the site and shall be dust and vermin proof. All parts and surfaces which are subjected to corrosion shall be made of such material and shall be provided with such protective finishes as would protect the equipment installed from any injurious effects of excessive humidity. All electrical auxiliary equipment shall be specifically tested for tropical conditions and the materials for this treatment shall be as per modern Engineering practices.

1.07: ELECTRICITY RULES:

All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules framed there under and as amended from time to time.

1.08: TYPE AND RATING:

The Power Transformers shall be of 3 phase, core type construction, oil immersed and shall be suitable for outdoor service as step-down as well as step up transformer.

1.08.1: 80/100 MVA, 220/33 kV Power Transformers are required for installation at 4Nos. 220kV Sub-Stations of Nokh (Jaisalmer) Solar Park. These power transformers may be required to run in parallel with other transformers of the similar capacity & voltage ratio
(220/33KV) having similar characteristics. The measured impedance of transformer at normal, minimum and maximum taps shall match with the other 220/33 KV transformer(s), so that transformer can run in parallel with other 220/33KV transformer(s). The technical particulars of transformers required are as under:

<table>
<thead>
<tr>
<th>SNo.</th>
<th>PARTICULARS</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Max. Continuous rating of transformer at ref. ambient Temp. specified under clause 5.02.</td>
<td>ONAN- 80 MVA ONAF- 100 MVA</td>
</tr>
<tr>
<td>ii)</td>
<td>Frequency.</td>
<td>50 Cycles</td>
</tr>
<tr>
<td>iii)</td>
<td>No. of phases.</td>
<td>3 phase.</td>
</tr>
<tr>
<td>iv)</td>
<td>a) Highest voltage for high voltage winding.</td>
<td>245 KV rms</td>
</tr>
<tr>
<td></td>
<td>b) Highest voltage for low voltage winding.</td>
<td>36 KV rms</td>
</tr>
<tr>
<td>v)</td>
<td>Nominal voltage ratio of transformer at principal tap.</td>
<td>220/33 KV rms</td>
</tr>
<tr>
<td>vi)</td>
<td>Winding connection:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) High voltage (HV)</td>
<td>Star Solidly grounded neutral</td>
</tr>
<tr>
<td></td>
<td>b) Low voltage (LV)</td>
<td>Star Solidly grounded neutral</td>
</tr>
<tr>
<td></td>
<td>c) Vector group</td>
<td>YNyn0</td>
</tr>
<tr>
<td>vii)</td>
<td>Type of cooling</td>
<td>ONAN/ONAF</td>
</tr>
<tr>
<td>viii)</td>
<td>a) The transformer shall be provided with 'On Load' Tap Changer which shall have 16 steps of 1.25% each for the voltage variation of +10% to -10% of the rated voltage on the HV side with constant voltage on LV side (i.e. constant flux regulation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) 'On Load' Tap Changer shall be capable of delivering rated MVA capacity of the transformer at all tap positions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) OLTC shall be suitable for step up/step down transformation.</td>
<td></td>
</tr>
<tr>
<td>ix)</td>
<td>Percentage impedance (on 100 MVA base) at normal voltage and 75 degree C Temp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) At principal tapping (Tap No. 9)</td>
<td>12.5% &amp; tolerance as per IS -2026</td>
</tr>
<tr>
<td></td>
<td>b) At Minimum tap (Tap No.1) (Having highest voltage &amp; lowest current)</td>
<td>13.75% Max. without any Positive tolerance</td>
</tr>
<tr>
<td></td>
<td>c) At Maximum tap (Tap No. 17) (Having lowest voltage &amp; highest current)</td>
<td>11.25% Min. without any negative tolerance</td>
</tr>
</tbody>
</table>
| x)   | Max. current density in all parts of HV (including tapped winding)/LV | <--- 3 Amps./sq.mm--->
| xi)  | Max. flux density in core | <---16000 Lines/sq.cm--> |
| xii) | Type of Terminal Connectors for HV and LV bushing terminals | Bimetallic connectors (with Bimetallic strip of min. 2 mm thickness) of horizontal/ vertical takeoff type suitable for: |
|     | a) Single "AL-59" (Moose) conductor for HV bushing terminals. | |
|     | b) Twin Tarantula AAC conductor having sub spacing preferably 300 mm for LV bushing terminals. | |
| xiii) | Permissible Temp. rise over an ambient of 50 deg. C (irrespective of Tap): | |
|     | a) Top oil | 50 deg. C |
|     | b) Winding | 55 deg. C |
| xiv) | Loading capacity | Continuous operation at rated MVA on any Tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS: 6600/IEC-60076-7. |
| xv)  | Air clearance | As per CBIP |
| xvi) | Efficiency at 75 deg. C at 0.85 power factor | > 99.5% |
**Rail gauge:** The rail gauge shall be three Nos. at equal distance of 1676 mm each across the length of transformer tank and two Nos. rail gauges at a distance of 1676 mm along the length of transformer tank.

1.09: INSULATION:

1.09.1: The dielectric strength of the winding, given insulation and the bushings shall conform to the values given in IS: 2026 (Part-III)/1981 (or its latest amendment) for rated system voltage of 245 KV & 33 KV and shall be suitable for the following impulse test voltages.

<table>
<thead>
<tr>
<th>SYSTEM VOLTAGE</th>
<th>IMPULSE TEST VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>245 kV</td>
<td>950 kVp</td>
</tr>
<tr>
<td>36 kV</td>
<td>170 kVp</td>
</tr>
</tbody>
</table>

1.09.2: The HV winding of the transformers may have graded insulation but the LV (33kV) winding shall have uniform insulation. The insulation class of neutral end of the windings shall be designed/rated for 95 kVp & 38 kV (Power Frequency voltage). The LV winding insulation class of the neutral end of winding shall be designed/rated for 170 kVp & 70 kV power frequency voltage.

1.10: TEMPERATURE RISE:

Each transformer shall be capable of operating continuously at their normal rating without exceeding temperature rise limits as specified below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Part</th>
<th>Temp. rise</th>
<th>External cooling medium (air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Windings (Temp. rise measured</td>
<td>55 deg. C.</td>
<td>The Air circulation is forced directed.</td>
</tr>
<tr>
<td></td>
<td>by Resistance method)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Top Oil (Temp. rise measured</td>
<td>50 deg. C.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>by Thermometer method)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The reference temperature conditions for which the transformers shall be designed are as under:

a) Max. Ambient air Temp. : 50 degree C.
b) Max. daily average Ambient air Temp. : 45 degree C.
c) Max. yearly weighted average Ambient temp. : 35 degree C.

The hottest spot temperature shall not exceed 98 degree C over an annual weighted average ambient temperature of 35 degree C. The transformer shall be capable of being over loaded to 150% of its rating in accordance with provision of IS: 6600-1972/IEC60076-7 and for this purpose:

(a) Bushing and its terminal connectors shall have minimum continuous current rating corresponding to 120% of rated current of transformer at lowest tap (i.e. extreme minus tap having max. current).

(b) Through current of OLTC shall correspond to 150% of rated current of transformer at lowest tap (i.e. extreme minus tap having max. current).
1.11: PARALLEL OPERATION:

The transformers covered in this specification are to be run in parallel with other transformers of same rating at the Sub-stations, as such the characteristics of the transformers will be identical so as to enable these transformers to run in parallel with the other transformers. The trend of percentage impedance at various Taps of existing transformers have been mentioned hereunder:

Percentage impedance at 75 deg. C. between HV-LV windings. (Positive sequence):

On principal tap (Tap No. 9) : 12.5 %
On extreme Taps : Within +10% of impedance on principal tap including tolerance.

The particulars given will enable the bidder to quote for suitable transformer. If any other particulars are required, the same can be supplied to the successful bidder at the time of placing the order. However, no delivery extension on the ground of non-receipt of any technical information will be granted, since adequate information has already been furnished. It shall be bidder’s responsibility to obtain any further technical information/clarification, if required by him.

1.12: IMPEDANCES:

Supplier(s) shall indicate the guaranteed impedances and tolerances taking into account, the limits at minimum and maximum tap positions so as to fulfill the requirements of clause 5.11 above. Impedances shall include positive and zero sequence and shall be expressed in terms of the branches of the star connected equivalent circuits all on the same MVA base. Range shall be given for each branch of the equivalent circuit in turn.

1.13: GUARANTEES:

1.13.1: The bidders are required to offer the Transformers having ‘No Load’ & ‘Load’ losses not exceeding the following values, without any positive tolerance:

(i) No load losses at rated voltage, normal ratio & rated freq. : 38 kW.
(ii) Load losses at rated current, normal ratio, rated freq. & 75 deg. C including auxiliary loss. : 250 kW.

‘No Load’ loss in kilowatts at rated voltage and rated frequency and the total losses in kilowatts at rated output of all the winding at rated voltage, rated frequency and 75 deg. C shall be guaranteed under penalty for each transformer. For the purpose of penalty computation, the test figures of the ‘No Load’ losses, ‘Load’ losses in all windings and total losses as actually obtained on the test bed will be compared with the corresponding guaranteed figures mentioned by the bidder/supplier in the Schedule of guaranteed technical particulars. The transformers shall be subject to ‘Heat Run’ test corresponding to maximum guaranteed values of the total losses of all windings (i.e. HV & LV).

The bidders quoting losses more than the values prescribed above in GTP shall be rejected. No benefit shall be allowed to the bidders quoting losses less than the above prescribed values.

1.13.2: The following recoveries shall be made for the excess losses up to the prescribed limits as above:

(i) Recovery for excess of ‘No Load’ losses : Rs. 3,32,000.00 per kW.
(ii) Recovery for excess of ‘Load’ losses & Aux. losses : Rs. 1,36,000.00 per kW.

For fraction of a kilowatt, the recoveries shall be applied prorata.
1.13.3: Since Indian and other standards allow certain tolerance for acceptability of the transformer for 'No Load' & 'Load' losses. The bidders are requested to indicate whether the figures given for guaranteed losses in schedule of guaranteed technical particulars are with or without such tolerances. If tolerances are applicable, the limits for the same should be indicated. In the absence of any intimation to this effect, the figures for 'No Load' & 'Load' losses (including Auxiliary losses) will be increased by the following tolerances provided in the Indian standards:

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total losses</td>
<td>10%</td>
</tr>
<tr>
<td>Component losses</td>
<td>15% of each component losses</td>
</tr>
</tbody>
</table>

1.13.4: The purchaser reserves the right to reject any transformer, if during tests at supplier’s works, the tested No Load/Load losses and total losses exceed the corresponding max. guaranteed losses (including tolerance as per clause 1.13.3, if any) by more than the following values:

- **a)** Total losses : +10% of the max. total guaranteed (including tolerance if any) losses of all windings including auxiliary losses.
- **b)** Component losses : +15% of each component (including tolerance, if any) losses provided that the limit as at (a) above for total losses (including tolerance, if any) is not exceeded.

The transformer could also be rejected, if excess losses are less than above limits but calculations suggest that there is not enough margin in the Temp. Rise values to be contained within permissible limits to absorb such losses unless Temp. Rise test is repeated on the transformer free of cost.

1.13.5: For the purpose of comparison of tenders, the quoted prices shall be capitalized for the 'No Load' losses and 'Load' losses in two windings (HV+LV) including Auxiliary losses at the same rate as given at clause No. 1.13.2 for the penalty/recovery, on the basis of max. guaranteed losses figures including tolerance, if any. The Auxiliary losses shall be the losses for two groups of cooler fans. Losses for standby arrangement will not be accounted for penalty/capitalization purpose.

1.13.6: The supplier shall provide the design details of core assembly showing the construction details, core diameter, net/gross sectional area of the core assembly etc. The information must also be given in respect of volts per turn at principal tap for normal voltage. The loss curves for type/grade of steel laminations being used for the core shall also be provided along with the tender.

1.13.7: No changes in the tender value of transformer losses will be permitted after opening of the tender and evaluation of tender will be carried out on the basis of information furnished in the tender.

1.14: COOLING:

1.14.1: Each Power Transformer shall be provided with ONAN/ONAF type cooling for 100 MVA as specified under the schedule of requirements.

1.14.2: The ONAN cooling of the transformers shall be by natural circulation of air while the circulation of oil shall be effected by natural convection, the maximum oil flow being assured by a method whereby the return flow of cooled oil is made to enter the tank at a level coinciding with the bottom of the hot columns of oil thus avoiding centre heads of cold oil at the bottom of the tank. Out flow shall be arranged to coincide as nearly as possible with the hot oil level at the top of the tank so that the total available difference will be fully employed in circulating the oil round the shortest possible paths.
1.14.3: The windings of the transformers shall be designed to deliver continuously, rated MVA corresponding to ONAN/ONAF cooling for 100 MVA Transformers. Each transformer with ONAF rating shall be provided with two completely independent groups of cooler fan banks, each of 50% capacity, with their structures, suitable for mounting on a flat concrete base, held by grouting bolts in the foundations. Cooling fans shall not be directly mounted on radiators. In addition, each transformer shall be provided to standby cooler fans equivalent to 25% capacity of main cooler fans subject to a minimum of one cooler fan per group.

The standby cooler fans shall be switched on automatically in case of failure of equivalent cooler fans in that group of coolers.

1.14.4: The cooling arrangement for each transformer therefore shall be as follows:

(i) 100 MVA Transformer with: 2 groups of 50% cooling fans each and 25% additional fans ONAN/ONAF cooling (subject to a min. of 1 fan/group) in each group as standby.

Necessary details and number of foundation holding down bolts, nuts, plates and other fixtures required for above shall be furnished by the bidder/supplier.

1.14.5: The cooler bank shall be provided on either side when viewing the transformer from HV side (i.e. Left or Right) as per site requirement. This shall be intimated after placement of PO. The successful bidder shall design the transformer accordingly.

1.14.6: The transformer shall be capable of delivering the rated output continuously at all taps with groups of coolers mentioned above in service without exceeding the specified temperature rise. The transformer shall be capable of delivering its rated MVA for ten minutes with loss of all cooling equipment while the transformer is carrying full load, without injurious heating of the transformer.

1.14.7: All the fans in two groups of cooler fans shall be arranged to start automatically when the winding temp. exceeds a pre-set adjustable temperature to be specified by the supplier.

1.14.8: The supply, controls and piping of each group of cooler fans shall be completely independent of those of the other group so that either group of cooler fans can be taken out of service for maintenance, with the transformer and the other group of cooler fans in service.

1.14.9: Coolers shall be designed to withstand the pressure conditions specified for the tank and shall be designed so as to be accessible for cleaning and painting to prevent accumulation of water on the outer surfaces. Cooler bank/radiators shall also be suitable for full vacuum as for the transformer.

1.14.10: The connecting pipe between the tank and the cooler units shall be connected on either side by machined steel flanges welded to the cooler units and the tank and provided with gaskets to ensure no leakage whatsoever. At each cooler unit connection, there shall be provided on the tank, an indicating shut off valve which can be fastened in either open or close positions. Separate oil tight blank flange shall be provided for each tank connection for use when the cooler unit is detached.

1.14.11: In addition to above, each cooler bank shall also be provided with the following:

(i) A drain valve 25 mm at lowest point.
(ii) A thermometer pocket fitted with a captive screwed cap on the inlet and outlet oil branches.
(iii) A filter valve at the top and bottom.
(iv) Air release plug 15 mm.
A suitable expansion piece shall be provided in each oil pipe connection between the transformer and the oil coolers in case of separate mounting. The power supply available for the cooling system shall be 415V, 3-phase, 4wire. All the mechanism should be designed accordingly.

1.14.12: AIR BLOWERS:

1.14.12.1: Air blowers for air blast cooling shall be suitable for continuous outdoor operation and shall be mounted separately so as to ensure that no damage to the coolers can occur due to vibrations of fans.

1.14.12.2: Air blower shall be suitable to start direct on line.

1.14.12.3: Air blower shall be designed so that they operate with a minimum of noise or humming. It shall be possible to remove the blower complete with motor without disturbing or dismantling the cooler structure frame work.

1.14.12.4: Blades shall be suitably painted for outdoor use. For fans painted wire mesh guards with mesh not greater than 25 mm shall be provided to prevent accidental contact with the blades. Fans mounted shall be provided with outside guards against birdage. Guards shall be provided over all moving shafts and couplings.

1.14.13: COOLER CONTROL:

1.14.13.1: Cooler units shall be suitable for operation with a 415V, 3-phase, 50 cycles power supply. Control equipment for fan motors shall be mounted in a marshalling box adjacent to the transformer & shall include necessary three pole electrically operated contactor and starting/ stopping the motor manually and also automatically from the contacts of the winding temperature indicating device. Over load and single phase protection shall be provided. A ‘No’ Volt relay shall also be fitted. (Single phase protection and ‘No’ Volt relay functions can be combined in one common relay). A single metal clad main isolating switch with MCB shall be provided for the main supply.

1.14.13.2: The cooling equipment shall have provision for visual alarm indication for the following in the control room on the transformer indoor tap changer control panel to be supplied by the firm as per Clause 5.21.10:

(i) The auto/manual position of the selector switch for the cooling equipment.
(ii) That the first set of contacts of the winding temperature indicator have closed.
(iii) That the second set of contacts of the winding temperature indicator have closed.
(iv) Fans in group "A" ON indication.
(v) Fans in group "B" ON indication.
(vi) Standby fan in group "A" "ON" indication.
(vii) Standby fan in group "B" "ON" indication.

In addition, provision shall also be made for visual as well as audio alarm indication for the following on the above control panel. It shall be possible to obtain visual and alarm indication of an alarm even, if previous alarm has not reset or persisting:

(i) Failure of any fan in group "A"
(ii) Failure of any fan in group "B"
(iii) Failure of AC supply to control equipment.
(iv) Failure of standby fan in group "A"
(v) Failure of standby fan in group "B"

Besides above, remote electrical manual control of both groups of cooler fans including separate control of standby fans shall also be provided on the above control panel.
selected in local service mode, switches for each fan of group A&B should be provided for ON or OFF operations.

1.14.13.3: Bidder shall specify the loading capacity of transformer in case of failure of one or more fans. Provision should be made to avoid hunting of fans.

1.15: TRANSFORMER CORE:

1.15.1: The core shall be built up with thin laminations of high grade, non-ageing, low loss, high permeability, cold rolled grain oriented silicon steel specially suitable for transformer core and having prime quality. The particulars of laminated steel to be employed shall be supplied by the bidder along with watt loss and thickness of core.

Successful bidder/supplier shall furnish copy of purchase order for procurement/importing the prime core material for the ordered transformer immediately after the same is finalized. The supplier will furnish documents relating to import of core material (either directly or through other agency on whom order is placed for supply of core material) such as copy of purchase order, bill of lading, supply invoices, mill’s test certificate for Watt loss per Kg, packing list and bill of entry certificate by custom before offer for stage inspection of core assembly.

1.15.2: After being sheared the laminations shall be treated to remove all burrs and shall be re-annealed to remove all residual stresses, if required. At least one side of each lamination shall be coated with a double baked enamel insulation coating or the CRGO sheets shall be provided with high quality in-organic coating, which will not deteriorate due to pressure and the action of hot oil. The nature of insulation shall be specified by the bidder.

1.15.3: Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable, the laminations are flat and the finally assembled core is free from distortion.

1.15.4: The design of the magnetic circuit shall be such as to avoid discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at right angles to the plane of the laminations which may cause local heating.

1.15.5: The core shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibration during operation. The core/clamping bolts shall not pass through core/yoke and clamping structure shall be so constructed that eddy current will be minimum.

1.15.6: The core shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformer. The core and the coil shall be so fixed in tank that shifting will not occur when the transformer is moved or during a short circuit or during transportation.

1.15.7: The core and yoke points of all transformers shall be brought outside the tank and facility for testing and earthing shall be provided on the tank cover.

1.15.8: FLUX DENSITY:

The flux density in any part of the core built from cold rolled grain oriented steel shall not exceed 16000 lines per sq. cm at any tap position necessary to maintain ‘No Load’ terminal voltage of 33 KV on LV side as required. The transformer shall also be suitably designed to withstand up to 15% upward primary voltage variation at normal tap continuously without saturation and excessive heating of the core and windings. Due regard shall also be given to the limiting flux density based on the characteristics of the material used. The bidder shall indicate maximum flux
density in core/yoke at rated voltage to establish the maximum flux density at 15% over voltage (with reference to nominal voltage) does not cause core saturation. The bidder/supplier shall furnish magnetization curve for material indicating maximum working flux density without saturation.

1.16: WINDING:

1.16.1: The windings shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable and field repairs to the windings can be made readily, without special equipment. The coils shall be supported between adjacent sections by insulating spacers and bracers. Bracings and other insulation used in the assembly of the windings shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings. The windings shall be designed to reduce to a minimum the out of balance forces in the transformer at all ratios.

1.16.2: The insulation of the coils shall be suitable to develop the full electrical strength of the windings. All materials used in the insulation and assembly of the windings shall be insoluble, non catalytic, and chemically inactive in the hot transformer oil and shall not soften or otherwise be adversely effected under the operating conditions.

1.16.3: All threaded connections shall be provided with locking facilities. All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used. Condenser rings shall be provided on HV winding.

1.16.4: The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. The assembled core and windings shall be vacuum dried and suitably impregnated. The electrolytic copper conductor used in the coil structure shall be best suited to the requirements and all permanent current carrying joints in the windings and the leads shall be welded or braced except compression type which may be used for terminal connections. Bolted connection may be used at the bushings and at terminal board with suitable locking device. The drying out procedure of the core coil assembly shall be indicated in the tender.

1.17: FAULT WITHSTANDING CAPACITY OF WINDINGS:

All the windings shall be suitably designed to withstand Short Time rating for not less than 3 seconds by feeding the fault level of 20000 MVA on HV side and 1000 MVA on LV (33 KV) side from both ends and considering the severe most form of system faults that can arise in service. The zero sequence impedance of the transformer shall also be ascertained by performing the actual testing in case of successful tender(s). Bidder/supplier should furnish the detailed calculations for thermal as well as dynamic ability of windings to withstand Short Circuits as prescribed above, failing which their quotations would likely be ignored. The max. temp. attained for short time rating shall not exceed 220 degree C.

1.18: INSULATING OIL:

1.18.1: The oil for first filling together with 05% extra shall be supplied with each transformer. The oil shall be New Insulating Oil and shall comply IS: 335/1993 (latest amendments, if any). The characteristics of the oil in respect of the following shall not, however, be inferior to the values specified below:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Characteristic</th>
<th>Requirement</th>
<th>Method of tests reference to</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Neutralization value:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
a) Total acidity (Max.) : 0.01 Mg-KOH/gm
b) Inorganic acidity/ alkalinity: Nil

3. Electrical strength (KV rms) (Break down voltage) of new unfiltered oil (Min.)
   : 40 KV rms
   IS:6702/1972 & Notes of table-1 of IS:335

4. Specific resistance at 90 degree C (min.)
   : 12
   IS:6103/1971 & Note 1 & 2 under table-1 of IS:335.

5. Oxidation stability
   a) Neutralization value after oxidation, (Max.)
      : 0.20 mg-KOH/gm
      As per appendix-B of IS:335/1983.
   b) Total sludge after oxidation, (Max.)
      : 0.05 % by weight

6. Water content (Max.) : 30 PPM, Appendix-E, See Note-3 of table-1 of IS:335.

7. S.K. Value (Max.) : 6%.

8. Dielectric dissipation factor after ageing (Max.)
   : 0.15

1.18.2: Particular attention shall be paid to deliver the oil free from moisture having uniform quality throughout in the non-returnable new steel drums of grade ‘A’ Type-2 as per IS-1783 (Part-1)-1993.

1.18.3: The quantity of oil for first filling of each transformer shall be stated by the bidder and will be measured during routine testing by first draining out the oil from transformer (complete with radiators) and then filling the transformer (complete with radiators) up to normal oil level in the conservator. The 10% quantity of spare oil will be determined & supplied by bidder on the basis of actual measurement of oil quantity by our inspecting officer for first filling including for toping up.

1.18.4: The oil for first filling and 05% spare shall be supplied in brand new non returnable steel drums of Grade-‘A’ Type-2 as per IS-1783 (Part-1)-1993 and transformer tanks shall be dispatched filled with Dry Nitrogen/ Dry Air along with sufficient number of Nitrogen/ Dry Air cylinders to maintain the pressure.

1.19: TANK:

1.19.1: The transformer tank and cover shall be fabricated from good commercial grade low carbon steel suitable for welding and of adequate plate thickness. The tank and the cover shall be of welded construction. All seams shall be welded and where practicable they shall be double welded. The transformer tank shall have sufficient strength to withstand without permanent distortion (i) filling by vacuum of 0.2 Torr (ii) The tank cover shall be bolted to the tank and the transformer design shall be such that the tank will not split between the lower and upper cooler connection for un-tanking. The transformer tank of bell type construction shall also be acceptable. The slope of tank cover shall be such that water does not accumulate on it.

1.19.2: At least one manhole inspection cover with a welded flange and a bolted cover shall be provided on the tank cover. The manhole shall be of a sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
1.19.3: All bolted connections to the tank shall be fitted with suitable oil tight gaskets which shall give satisfactory service under the operating conditions. Special attention shall be given to the methods of making the hot oil tight joints between the tank and the cover as also between the cover and the bushing and all other outlets to ensure that the joints can be remade satisfactorily and with ease, with the help of semi-skilled labour. Where compressible gaskets are used, steps shall be provided to prevent over compression. Suitable guides shall be provided for positioning the various parts during assembly or dismantling.

1.19.4: Lifting eyes or lugs shall be provided on all the parts of the transformers requiring independent handling during assembly or dismantling. In addition the transformer tank shall be provided with lifting lugs and bosses properly secured to the sides of the tank, for lifting the transformer either by cranes or by jacks.

1.19.5: The design of the tank, the lifting lugs and bosses shall be such that the complete transformer assembly filled with oil can be lifted with the use of these lugs without any damage or distortions. The tank shall be provided with two suitable earthing pads (each complete with 2 Nos. tapped holes suitable for connection of MS grounding flat) shall be provided at suitable position close to earth but at sufficient distance from rail rollers on diagonally opposite bottom corners of the tank and earthing strips of flexible copper between the tank and top cover of the transformer for the purpose of grounding.

1.20: UNDER CARRIAGE:

1.20.1: The transformer tank shall be supported on a structural steel base equipped with forged steel or cast steel, single flanged wheels suitable for moving the transformer completely filled with oil. The base of the tank shall be suitable for sliding the transformer tank on rails.

1.20.2: Jacking pads shall be provided. It shall be possible to change the direction of the wheel through 90 degree when the transformer is lifted on jacks to permit movement of the transformer both in longitudinal and transverse direction. The rail gauge shall be three Nos. of equal distance of 1676 mm each across the length of transformer tank and two Nos. rail gauge at a distance of 1676 mm along the length of transformer tank.

1.20.3: Pulling eyes shall be provided to facilitate moving the transformers and they shall be suitably braced in a vertical direction so that bending does not occur when the pull has a vertical component.

1.20.4: ANTI EARTH QUAKE DEVICES:

The transformer shall be rigidly mounted on wheels resting on rails grouted in concrete foundations. The complete transformer shall be rigidly anchored through wheel assemblies to the foundations using anti earth quake clamping and locking devices. Tender's scope of supply shall include the requisite foundation bolts/clamping bolts and locking devices and all other accessory equipment. The arrangement shall be such that the transformer can be fixed to or unfastened from those bolts as desired. The location of locking device shall not foul with that of jacking pads.

1.21 ON LOAD TAP CHANGING MECHANISM:

1.21.1: Each transformer shall be provided with an on load tap changing mechanism. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation. Suitable interlocking device shall be provided, so that it shall not be possible to operate the electric drive when the hand operating gear is in use. Further, it shall also not be possible to simultaneously operate the local electrical as well as remote control. All electrical control
switches and the local operating gear shall be clearly labelled in a suitable manner to indicate the direction of tap changing. The diverter switch shall be so designed as to ensure that its operation once commenced shall be completed for one step only independent of the operation of the control relays, switches or failure of auxiliary supply etc. Adequate safe guards shall be provided to safe guard the transformer and its auxiliaries to meet any contingency of incomplete operation of diverter switch. Limit switches shall be provided to prevent over running of the mechanism under any condition. A 5 digit counter shall be fitted to the on load tap changing mechanism to indicate the number of operations completed by it.

1.21.2: The on load tap changer shall include the following:

(a) Single phase acting tap selector switches to select appropriate tap.
(b) Single phase acting diverter switches of resistor transition type.
(c) Motor driven mechanism.
(d) Control and protection devices.
(e) Manual operating device.
(f) Local tap changer position indicator. (Analogue/Mechanical type)
(g) Remote tap position indicator. (Analogue/Digital type)
(h) 5 Digit counter as mentioned above.

1.21.3: The tap selector switches and diverter switches shall be housed in different compartments built within the main transformer tank. While tap selector shall carry rated current it will not be used to make or break the current. Make or break of current and consequently arc suppression after tap selection shall be performed in the diverter switch. The oil in the diverter switch compartment shall, therefore, be prevented from mixing with the main tank oil. The diverter switch compartment shall be provided with means of releasing gas produced by arcing. Buchholz relays of oil surge type shall be provided within the conduits feeding oil to the diverter switch compartments from a separate conservator will be provided with oil filling hole with cap and drain valve. These relays shall be in addition to the main Buchholz relay provided for protection of windings as specified under clause 5.25 (xi) and shall be equipped with trip contacts. The tap selector switch may be directly exposed to main tank oil.

1.21.4: Suitable arrangements shall be provided for drawing out or filtering the oil in the compartment separated from main tank without dismantling the same from main tank. A separate OLTC conservator shall be fitted with individual oil level gauge and breather at level lower than main conservator so that oil leakage between main tank OLTC and diverter switch can be detected. The silica gel breather shall be provided with oil seal. The oil filter and Suction pipes with drain valves for diverter switch compartment shall be brought down the tank at a convenient operating height.

1.21.5: The transformer shall be capable of carrying rated MVA on all taps. The breaking capacity of the ‘On load’ tap changer shall be compatible with the highest system voltage and current based on maximum over loading permissible under IS: 6600-1972 (150% of rated value). The voltage rating for each step shall be 1.25% on HV. However, each step of OLTC shall withstand voltage not less than 115% of rated step voltage i.e. 1.25% of the nominal phase to neutral voltage of the HV winding (220/3 KV rms). The rated through current of OLTC at this voltage will not be less than 150% of rated current of HV winding at lowest tap. The OLTC shall be such as to permit rated current in either direction.

1.21.6: The manual operating device shall be so located on the transformer that it can be operated by a man standing at the level of the transformer tracks. It shall be strong and robust in construction.

1.21.7: The tap changer shall be capable of permitting parallel operation with other transformers of the same type. The control scheme for the tap changer shall be provided for independent
control of the tap changers when the transformers are in independent service. In addition, provision shall be made to enable remote electrical parallel control also, so that the tap changer can be operated simultaneously when one unit is in parallel with another of same type as mentioned above and under normal conditions the tap changer will not become out of step. Features like master, follower shall be incorporated for such group simultaneous control. Suitable selector switch shall be provided so that any one transformer of the group can at a time be selected as Master, Follower or ‘Independent’. The scheme will be such that only one transformer of a group can be selected as Master. Necessary interlock blocking independent control when the units are in parallel shall be provided.

1.21.8: Under abnormal conditions such as may occur if any contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the tap should be furnished by the tenderer.

1.21.9: The contactor and associated gear for the tap change driving motor shall be housed in a local kiosk (separated from marshalling box) mounted adjacent to or on the transformer. The motors shall be suitable for operation with 415V, 3phase, 50 cycles or 230V single phase, 50Hz external power supply. Thermal devices or other means shall be provided to protect the motor and control circuits. All relays, fuses, switches etc. shall be mounted in the above driving gear housing and shall be clearly marked to indicate their purpose. A five digit counter shall be fitted on the tap changer mechanism to indicate the number of operations completed by the equipment.

1.21.10: The supplier shall supply, in addition to the equipment above, a remote control panel to be installed in the Control Room for remote operation of ‘ON Load’ Tap changer. Such remote control panel shall include amongst others, the following accessories:

(i) Tap changer supply isolation switch ON/OFF with supply ON Lamp.
(ii) Raise and lower push button switch and facility to raise/lower Tap by SCADA also.
(iii) Sequence selector switch OFF/Independent/Follower/ Master.
(iv) Remote tap position indicator (Analogue/Digital) and buzzer.
(v) An indicating lamp and buzzer showing tap changing in progress.
(vi) Name plate for each component.
(vii) ON/OFF indicating for all the fans provided on the cooling equipment.
(viii) The RTCC Panel shall have dimensions of 2312 x 610 x 610 mm, made of CRCA sheet. The thickness of front panel door frame etc. shall be 3 mm (10 SWG) while doors, side panels may be 2 mm (14 SWG). The degree of protection of enclosure shall be IP-31. The terminal board in RTCC panel should have stud and bolt type terminals.
(ix) Out of step/tap change stuck annunciation (Visual & audio).
(x) Auxiliary transformer, if any required for RTCC panel.

In addition, all indications and control for cooler control specified under clause 1.14.13.2 and repeater instruments specified under clause No. 1.25.1 (i) and (ii) shall also be provided on this remote control panel.

1.21.11: Complete particulars of the tap changing gear including the capacity of the motor shall be stated by the bidder.

1.21.12: The OLTC should be suitable for bi-directional power flow so as to enable us to use any of the transformers as step-up or step-down transformer.

1.22: OIL PRESERVING SYSTEM:

1.22.1: Oil preserving equipment shall be expansion tank conservator type consisting of Air Cell/Atmoseal system made of oil resistant nitrile rubber (“PRONAL” French make) which
is placed in the conservator and floats on the oil surface. Any other oil preserving system having better quality and design may be considered but it should be offered as an alternative. A silica gel breather shall be connected to the bellow, so that it is always at atmospheric pressure. The conservator shall also be provided with a magnetic oil level gauge.

1.22.2: The capacity of conservator between highest and lowest permissible levels shall not be less than 7.5% of the total cold volume of the transformer and cooling equipment (up to minimum conservator level). In case of failure of aircell/Atmoseal/diaphragm, the magnetic oil level gauge (or any other suitable mechanism) should give alarm.

1.22.3: A separate conservator of conventional expansion tank type shall be provided for ‘ON load’ Tap changer and its level shall be below the level of main conservator.

1.23: BUSHINGS:

1.23.1: All main winding and neutral leads for 220/33KV transformer shall be brought out through outdoor type bushings. The electrical characteristics of bushing shall be in accordance with IEC-137 as well as IS-3347 and IS-2099. The bushing shall be rated for highest voltage and current rating of the respective windings. The current ratings shall be 1250 Amps. for HV (245KV) bushings, 3150 Amps. for LV (33KV) bushings and 3150 Amps. for HV & LV neutral bushings. The creepage distance of all the bushings shall be at least 25 mm per KV in accordance with the requirements of IS: 2099. The Short Circuit rating of bushing should be 3 seconds. The insulation class of common neutral bushing shall be properly coordinated and specified with the insulation class of the neutral as per clause 5.09.2.

1.23.2: The bushings shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electrical clearances between bushings and between the bushings and ground parts after fixing of terminal connectors. The spacing between the bushings shall be adequate to utilize full flashover strength preventing flashover between the phases or between phase and ground parts under all conditions of operation.

1.23.3: All bushings shall be equipped with suitable solder less terminals of approved type. The type and size shall be specified by the bidder. All external current carrying contact surfaces shall be placed adequately.

1.23.4: Provision shall be made to enable measurement of Tan delta, PD etc. of the HV bushings.

1.23.5: Bushings of identical voltage ratings shall be interchangeable. Dimensions of 220 KV & 33 KV Bushings shall conform to those standardized by CEA.

1.23.6: All porcelain used in bushings shall be of the wet process homogeneous impervious to moisture and free from cavities or other flaws and throughout vitrified and smoothly glazed. The glazing shall be of the uniform colour and free from blisters, burrs and other defects. The 220 KV bushings of the power Transformer shall be of condenser oil filled type (OIP). However, for HV neutral, LV (33 KV) phase & LV neutral of the Transformer, bare bushing shall be used/provided. The condenser bushings shall be provided with test tapping as per clause No. 2.12 of IS 2099/1973. These condenser bushings shall also be provided with oil level indicator visible from ground level. All bushings shall have puncture strength greater than the dry flashover value. Re-entrant type bushings shall not be acceptable.

1.24: CENTRE OF GRAVITY:

The centre of gravity of the assembled transformer shall be low and as near the vertical centre line as possible. The transformer shall be stable with or without oil. If the centre of gravity is
eccentric relative to track either with or without oil, its location shall be shown in the outline drawing.

1.25: FITTINGS AND ACCESSORIES:

1.25.1: Each transformer shall be provided with the following fitting and accessories:

(i) One Dial type thermometer for oil with maximum pointer of robust pattern mounted in the marshalling box of the transformer at the convenient height to read the temperature in the hottest part of the oil and fitted with alarm and trip contacts. A repeater instrument shall also be provided for remote indication of oil temperature on RTCC Panel as per clause 1.21.10. Control cable for this purpose & its size shall be indicated in the documents.

(ii) Two winding hot spot temperature detectors, one each for HV and LV windings mounted in the marshalling box. The bushing CT having accuracy class of 1 or better for this purpose provided on HV and LV shall have appropriate No. of taps and taps to be selected to indicate winding temperature rise as determined by considering winding to oil temperature gradient as observed during temperature rise test on transformer/ identical transformers shall be indicated by the supplier. Additional pockets, if required for providing remote indication of winding temperature and oil temperature will also be provided on transformer top cover. Repeater instrument shall also be provided for remote indication of both winding temperatures on RTCC Panel as per clause 1.21.10. Control cable for this purpose & its size shall be indicated in the documents.

It shall be indicating type, responsive to the combination of top oil temperature and winding current calibrated to follow the hottest spot temperature of the transformer winding. The winding temperature detector shall have at least two sets of independently adjustable contacts to operate a remote alarm and trip in the event the hottest spot temperature approaches a dangerous value. Additional contacts of min. 2Nos. as needed shall also be provided to automatically actuate the fan motors at the preset adjustable values. The winding temperature indicator shall be 150mm dial type with maximum pointer and resetting device. The temperature detecting device shall consist of a current transformer, heating coil and a resistance coil wired and mounted inside the transformer tank or in the winding temperature indicator.

(iii) One magnetic type oil level gauge with low level alarm contacts and dial showing minimum, maximum and normal oil levels in the each in the main conservator and OLTC along with a provision for alarm on failure of Aircell/ Atmoseal system. A mark indicating the oil level at Oil temperature of 30 Deg. C. shall also be provided on the dial of magnetic oil level gauge. The gauge shall be readable from the transformer base level. Separate magnetic oil level gauge shall also be provided for OLTC conservator chamber with low level alarm. In addition, prismatic oil gauge shall also be provided for both main and OLTC conservators. The magnetic oil level gauge on main conservator shall also comply Clause 1.22.2.

(iv) One oil filling valve (inlet) on the conservator & of diverter switch.

(v) One oil drain valve for main tank.

(vi) One filter valve located at the top of the tank on the HV side. The opening of this valve shall be baffled to prevent aeration of oil.

(vii) One filter valve located near the bottom of the tank on the LV side of the transformer diagonally opposite to the top filter valve.

(viii) Oil sampling valves one at top of the tank and another at the bottom of the tank, preferably these should be mounted on the diagonally opposite sides of the tank with the bottom sampling valve on opposite side of bottom filter valve.
(ix) Air release device: It shall be of adequate capacity and shall be provided to release the trapped air during/after filling of the oil.

(x) An automatic resetting type spring controlled pressure relief device shall be provided which shall operate, if abnormal pressure is developed inside the transformer tank. It should also have alarm & trip contacts. Arrangements shall also be made to drain oil coming out of transformer during its operation. Pressure settings of PRD shall be 0.42-0.43 + 0.07kg./sq. cm (or 0.31 Kg. per sq. cm) plus approx. head due to level difference between conservator oil level and PRD level. PRD will have semaphore indicator visible from ground level.

(xi) Two Nos. double float gas detector relays (Buchholz relay) shall be provided with alarm and tripping contacts to detect accumulation of gas and sudden changes of oil pressure, each complete with shut-off valves on either side and flange coupling to permit easy removal without lowering oil level in the main tank, a bleed valve for gas venting, and a test valve. Out of these two Buchholz relay, one relay should have magnetic reed type contacts and other is conventional type. These Buchholz relays shall be so arranged (preferably in series) that both the relays simultaneously sense the accumulation of gas and actuate alarm and trip contacts. Failure of any one relay should not prevent other to energize alarm and trip circuitry. Additional oil surge relay, for diverter switch shall also be provided as per clause No. 1.21.3. The Buchholz relays shall be of best quality & make. If required, additional relay shall be provided to trip transformer, if oil level is low in the diverter switch.

(xi-a) The Buchholz relays shall be suitable for application in Seismic Zone of Horizontal acceleration of 0.3g and same shall be fitted rigidly with tank body so as to avoid its mal-operation under vibration due to through fault. The slope of the Buchholz relay pipe shall be 3 Deg to 5 Deg.

(xii) Radiators complete with fans etc. as necessary for cooling.

(xiii) (a) An oil conservator with Atmoseal/Aircell system/diaphragm to provide separation between oil and atmospheric air as per Clause No. 1.22.
(b) Oil preserving equipment complete in all respects as described in clause No. 1.22.

(xiv) Eye bolts and lugs on all parts for ease of handling.

(xv) Two grounding terminals as per clause No. 1.19.5.

(xvi) Rating, diagram and terminal marking plates for transformers and other accessories giving details as per I.S.S. shall be provided. Value of full wave (1.2/50 micro second) impulse level, Short Circuit current duration, weights of all important items, Impedances, loss values at normal/ extreme taps, details of OLTC and Performance guarantee period shall be specified on rating plate. Valve schedule plate shall also be provided.

(xvii) Bimetallic terminal connectors for HV and LV bushings and earthing clamps & strips for neutral bushings including insulators for grounding. The length of earthing strips should be up to the rail level.

(xviii) One set of indoor panel, details given as per clause 1.21.10 for remote tap change and cooler control.

(xix) Suitable weather proof cubicles (Marshalling box) for housing the local control equipment for fans, terminal blocks for current transformer secondaries and for mounting winding temperature indicators and oil temperature indicator as above (i) and (ii). The Marshalling box shall be made of CRCA sheet steel of thickness of 3.0 mm. The degree of protection of enclosure shall be IP-55. The alarm and tripping contacts should have sufficient space in between to avoid any damage since alarm contacts are potential free contacts. The Terminal Board in marshalling box should have stud and bolts type terminal.
(xx) Transformers shall be provided with required numbers of flanged bi-directional rollers. These shall be suitable for moving the transformer along and across its length on rails of rail gauge specified in specification.

(xxi) Hauling eyes shall be provided on all the four sides of the transformer base.

(xxii) Four, sturdy jacking pads shall be provided for lifting complete transformer to enable rotation of its wheels through 90 degree for pulling on transformer tank. Lifting height and safe capacity of jacks shall be specified by the bidder.

(xxiii) Two sets of forged or tested mild steel plate lifting lugs, one set for top cover, core and coil assembly and other set for complete transformer shall be provided. Lifting lugs shall be of adequate strength and size for attaching steel rope slings. Should lugs for lifting complete transformer be located on the base, sling guides shall be provided on cover.

(xxiv) Two inspection covers of sufficient size for access to the interior of the tank shall be provided on the cover. The inspection covers shall be provided with suitable lifting arrangements.

(xxv) Skids shall be provided at the bottom of the transformer tank.

(xxvi) Two silica gel breather with oil seal.

(xxvii) One set of four numbers of suitable Hydraulic jacks (common for all transformer on order) for lifting the transformer for changing the plane of rotation of the wheels shall be provided by the supplier. The jacks shall be hydraulic type in two parts (Jack and pump) with three meter long inter connecting hose pipe. The capacity of jacks should be at least 150% of the load on each wheel of the transformer with oil and accessories or 50 MT, whichever is higher.

(xxviii) Provisions shall be made for installing resistance temperature detectors (to be arranged separately) for temperature recording instruments in the Control Room for the following:

(a) Hot oil.  
(b) Winding hot spot.

Adequate thermometer pockets shall also be provided on the transformer tank and also at inlet and outlet oil headers. The thermometer pockets shall be fitted with captive screwed top to prevent the ingress of water when not in use.

(xxix) BUSHING CURRENT TRANSFORMERS:

Current Transformers (CTs) on each phase of HV, LV and neutral side (before star formation) and one in the neutral are required for High Impedance Differential and restricted earth fault (REF) protections and shall be provided in the appropriate manner in the bushings of the transformer. Technical particular of the CTs for above protection are given below:

<table>
<thead>
<tr>
<th>CT details</th>
<th>CT Ratio</th>
<th>Accuracy class</th>
<th>Burden (VA)</th>
<th>Knee point voltage (V)</th>
<th>Excitation Current (le) at Vk/2 (mA)</th>
<th>Rect @ 75 deg. C</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV</td>
<td>400/1-1</td>
<td>PS</td>
<td></td>
<td>&gt;300</td>
<td>120</td>
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<tr>
<td>LV before N</td>
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<td>PS</td>
<td>2000</td>
<td>30</td>
<td>&lt;10</td>
<td></td>
</tr>
</tbody>
</table>
**Note:** 1. This does not include CTs for WTI, parameters are to be decided by the manufacturer.
2. The parameters as above are indicative; these must be confirmed by manufacturer from RSDCL (as per protection requirement) for finalization.

All CTs (except WTI) shall be mounted in the turret of bushings; mounting inside the tank is not permitted. All terminals shall be provided as fixed type terminals on the Marshalling Box to avoid any hazard due to loose connection leading to CT opening. In no circumstances, plug in type connectors shall be used for CT. It shall be possible to remove turret mounted current transformers from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents and local heat generated in the turret. All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to transformer Marshalling box using separate cables for each one.

Bushing CTs of appropriate ratio and number of taps, VA burden shall be provided for winding temperature indicators. The accuracy class of Bushing CTs for winding temperature indicator shall be class 1 or better. The details of BCTs covered shall be indicated by the bidder.

**Lifting hooks shall be provided for taking out diverter switch of OLTC.**

**Detachable ladder with support for routine maintenance work/checkups. Addl. separate ladders with support, one each for maintenance of conservator tank and radiator shall also be provided.**

**PROVISION FOR PROVIDING NITROGEN INJECTION FIRE PREVENTION & EXTINGUISHING SYSTEM:**

The provisions shall have to be made by the supplier in the transformer for installation & commissioning of Nitrogen Injection Fire Protection System and 2 Nos. Top oil drain valve shall be provided for Nitrogen Injection Fire Prevention and Extinguishing System, one on each side of the transformer.

1.25.2: The equipment and accessories furnished with the transformer shall be suitably mounted on the transformer for ease of operation, inspection and maintenance and the mounting details shall be subject to the approval of the purchaser. All valves shall be provided either with blind companion flanges or with pipe plugs, for protection.

1.25.3: Indication lamps alarm and relay equipment shall have contacts suitable for operation generally with 220V DC supply, however, confirmation may be obtained before manufacturing the RTCC panels. Any other accessories or appliances recommended by the manufacturer for satisfactory operation of the transformer shall also be provided.

1.25.4: NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM:

1.25.4.1: Nitrogen Injection Fire Prevention & Extinguishing System should have the following:

5.25.4.2: The Nitrogen Injection Fire Prevention and Extinguishing system shall be suitable to operate on 220V DC which shall be available at 220KV GSS in our system. The Fire prevention & Extinguishing system shall minimum consists of the following and included in supplier's scope of supplies. However, any other accessories required for satisfactory operation of system shall be supplied by supplier free of cost:

(i) Fire Extinguishing cubical containing Nitrogen cylinder with regulator and falling pressure Electrical contact manometer, oil drain pipe with mechanical quick drain valve, electro mechanical control equipment for oil drain and pre-determined regulated Nitrogen release, pressure monitoring switch for back up protection for Nitrogen release
and system monitoring. This fire extinguishing cubical is to be placed on plinth at about 6 meters away from transformer plinth to be constructed by the supplier/contractor.

(ii) Control Box with activating, monitoring device and line fault indicators and DC to DC Converter from 220V to 110V DC as per requirement. This control box is to be placed in control room.

(iii) Pre stressed non return valve to be fitted in the conservator pipe operating mechanically, on transformer oil flow rate with electrical signal for monitoring.

(iv) Fire detectors to be placed on the transformer tank top cover.

(v) Signal box for placing on the tank side wall.

(vi) Oil drain and Nitrogen opening with gate valves on transformer tank, flanges with dummy piece in conservator pipe and fire detectors brackets on transformer top cover. Further, one additional oil drain valve shall be provided on opposite side of oil drain valve on transformer tank for NIFPE system.

(vii) Pipe connection between transformer-Fire extinguishing cubical and oil pit.

(viii) Cabling on transformer top cover and inter cabling between transformer-control box and Fire extinguishing cubical. The details and size of cables used are as under which are to be provided by the supplier:

(a) Fire survival copper cable 4 core x 1.5 mm sq. for connecting all fire detectors in parallel and terminating in signal box.

(b) FRLS 4 Core x1.5 sq.mm copper control cable for connecting:

- Pre stressed non return valve (PNRV) to signal Box.
- Fire extinguishing cubical for 230 Volts AC, single phase panel light supply.
- Connection from relay panel to control box.
- Connection from DC Panel to control box through DC converter.

(c) FRLS 12 Core x 1.5 sq. mm copper control cable for connection between transformer signal box to control box and between control box to Fire extinguishing cubicle (All copper control cables shall be multi strand cable).

(ix) Potential free contacts for required Electrical signals on relay panel for connecting to control box.

All the Civil works such as construction of plinth, oil pit below the transformer & others as per requirement shall be in supplier's/contractor's scope. Also, the detailed drawing & design of same shall be furnished by the supplier/manufacturer.

1.26: FACTORY ASSEMBLY AND TESTS:

1.26.1: The transformer shall be completely assembled and tested at the Factory. It shall be at the option of the purchaser to send his representative(s) for carrying out stage inspection and various tests during actual manufacture and assembly of transformer(s) so as to satisfy regarding the quality of product and material being used. The meters and instruments used for measurement of losses shall be of accuracy class 0.5 or better.

All the type and routine tests as per specification are to be conducted and no deviation in respect of conducting these tests will be acceptable. No extra charges for these tests will be paid. Test charges shall be part of cost of the equipment. Even if charges for such test are indicated elsewhere in the tender even then it will be presumed that these tests will be conducted free of cost and test charges, if quoted will be ignored. If purchaser deputes a representative to witness the tests, all tests shall be carried out in his presence. The vacuum test will be performed at pressure 3.33 KN/Sq. mt. but tank will be designed to withstand full vacuum.
1.26.2: STAGE INSPECTION:

The stage inspection will particularly include the following tests/checks, besides the general routine tests to be conducted during manufacturing stages as per manufacturer’s standard practice. No extra charges for any of the tests shall be quoted. No deviation shall be acceptable:

(a) Visual & dimensional check during assembly stage of Core including measurement of core area, verification of weight of CRGO material by measuring core dimensions and core cross sectional area, calculation of flux density and selection of sample of core material from assembled core and sealing by inspecting officer for checking of specific loss at 1.6 Tesla, magnetization characteristics (B-H Curve) & thickness from a Govt./Govt. approved/Govt. recognized testing laboratory by the supplier.

The supplier will furnish documents relating to import of core material (either directly or through other agency on whom order placed for supply of core material) such as copy of purchase order, bill of lading, supply invoices, mill’s test certificate for Watt loss per Kg, packing list and bill of entry certificate etc. by custom before offer for stage inspection of core assembly.

(b) Out of the ordered transformers, the transformer tank of first unit shall be subject to measurement of thickness of tank plates (Top, Bottom and sides) and to conduct pressure & vacuum tests as per procedure laid down in CBIP manual for transformer tests to ensure the adequate strength of tank plates. The supplier will furnish manufacturer’s test report for measurement of thickness of tank plates and pressure & vacuum test report for remaining transformer tanks manufactured by the same manufacturer before offering the transformer for final inspection. Otherwise, supplier will have to conduct the above test on transformer tank manufactured by other transformer tank manufacturer. For every manufacturer, transformer tank of first unit manufactured by the manufacturer shall be witnessed by RSDCL representative(s).

(c) Measurement of cross section area of winding, calculation of current density & also check for providing condenser rings on HV windings.

The value of specific core loss of core sample taken during core building, measured at a Govt. approved/Govt. recognized/NABL accredited lab shall be indicative & for reference purpose only. The transformer shall be considered acceptable as per the provisions of specification based on the losses measured during final inspection/testing.

To carry out the stage inspection, the supplier should intimate the complete schedule of manufacturing programme of these transformers at least 15 days advance directly to the Director (Technical) RSDCL, Jaipur.

The production shall not be interrupted in case purchaser’s representative does not reach as per the manufacturing programme to be intimated at least 15 days in advance.

5.26.3: ROUTINE TESTS:

Each completed transformer shall be subjected to following routine tests as per IS: 2026 Part-I to IV (latest amendment). If purchaser selects to have a representative, the tests shall be carried out in his presence. No extra charges for any of the tests shall be paid. No deviation shall be acceptable.

(a) Check complete transformer against approved outline drawing, provision for all fittings, finish oil level etc.
(b) Measurement of resistance of each winding.
(c) Measurement of turns ratio between HV-LV windings at each tap.
(d) Checking of polarity and phase relationships for each winding.
(e) Exciting current and its harmonics as per IS: 2026(Part. I)/1977 at 90%, 100% and 115% rated voltage and excitation losses at 90%, 100% and 115% of rated voltage.
(f) Positive phase sequence impedance/short circuit impedance between HV-LV windings on minimum, maximum and normal taps.
(g) (i) Zero sequence impedance between pair of windings i.e. HV-LV.
   (ii) Measurement of excitation current at low voltage (AC), say 3 phase, 415 V rms energization of HV and LV windings. The voltage of measurement will be indicated in the test report.
(h) Regulation at rated load at unity and 0.80 lagging power factors.
(i) Load losses measured at rated frequency by applying a primary/secondary voltage sufficient to produce the rated current in the windings with the primary/secondary windings short circuited. It is to be measured between HV-LV windings at minimum, maximum & normal taps.
(j) Measurement of insulation resistance.
(k) The total losses shall comprise of the ‘No Load’ losses, ‘Load’ losses and ‘Auxiliary’ losses at rated output, duly converted at 75 degree C average winding temperature and shall also be indicated in the test report. Load losses shall be that corresponding to rated load on HV & LV windings.
(l) Routine dielectric tests as per IS:2026 (Part I & III), 1981 (with latest amendment).
(m) Magnetic balance test.
(n) Tests on ‘On Load’ Tap Changer (as per IS:2026).
(o) Measurement of power taken by cooler fans.
(p) Measurement of capacitance and Tan delta of transformer winding and each HV & LV bushing. The Tan delta value of bushings/windings shall not be more than 0.5%.
(q) Measurement of acoustic noise level test on completely assembled transformer as per NEMA standards.
(r) Tests on transformer oil as per IS: 335 (latest amended) and to meet the requirements of EHV grade oil as per clause 5.18.1 of the specification. Since transformer tank is dispatched filled with Nitrogen/Dry air (Clause No 5.18.4) and oil for first filling and 10% spare shall be dispatched separately in steel drums, as such, one composite sample shall be drawn from each lot duly sealed by the RSDCL’s representative for complete testing at CPRI/ERDA as per IS: 335-1993 with latest amendment and this specification.
(s) Measurement of oil quantity in the transformer as per clause No 1.18.3.
(t) Leakage/Pressure test on completely assembled transformer as per procedure laid down in the CBIP manual.
(u) Frequency Response Analysis Test as per CBIP manual.

1.26.4: TYPE TESTS:

The bidder/supplier shall offer type tested transformer including Short Circuit test (as per IEC-60076) for this project. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the tests should have been either conducted at a Govt./ Govt. approved/ Govt. recognized/ NABL accredited/ ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) or should have been witnessed by the inspector (s) of RSDCL/any State Electricity Board or Company/Govt. undertaking (National or State)/CPRI etc. However, the first transformer shall be subjected to the following type tests. No extra charges shall be paid for these tests. The type tested unit shall be guaranteed for satisfactory normal use:

(a) Dielectric test as per IS: 2026/81 Part-III (with latest amendment, if any). The Lightning Impulse test along with chopped wave test shall be made in accordance with IS: 2026 (Part.III), 1981 (latest amended) on complete Transformer i.e. on both the limbs of the transformer of HV & LV windings. The tests on three phases of high voltage winding of transformer shall be performed on extreme taping and the principal taping respectively. Impulse tested unit shall have to be guaranteed for satisfactory normal use. The Impulse
test on one terminal will be with minimum tap, other with maximum and third with principle tap position.

(b) Short Circuit withstand capacity: In case the supplier/contractor has already got conducted the type test (Short Circuit as per IEC-60076) within last 7 years on its transformer, he may submit the type test report to RSDCL. In case, the supplier/contractor does not have the type test report of Short Circuit test then he may submit the data to prove the thermal and dynamic ability of its transformer to withstand Short Circuit under worst specified conditions as per provision of clause No. 9.1 & 9.2 of IS: 2026 (Part I).

(c) Temperature Rise Test as per IS: 2026/77 Part-II (latest amendment) at minimum tap (having maximum current) along with ‘Dissolved Gas Analysis’ test before and after Temp. rise test. Test losses, to be feeded during Temp. rise test shall be sum of guaranteed ‘No Load’ losses and two winding ‘Load’ losses at 75 degree Centigrade at extreme minus tap (having Max. current) considering HV & LV winding loading as 100 MVA & 100 MVA respectively and auxiliary losses or sum of measured ‘No Load’ losses & corresponding two winding ‘Load’ losses and auxiliary losses whichever is higher. The DGA test shall be carried out at CPRI/ ERDA on duly sealed oil samples by RSDCL representative.

All routine tests (except measurement of which is necessary for type test) will be conducted after type tests. All type tests shall be conducted on the same unit unless otherwise agreed to by the purchaser.

1.26.5: TEST ON NITROGEN INJECTION FIRE PREVENTION & EXTINGUISHING SYSTEM:

The Nitrogen Injection Fire Prevention & Extinguishing System shall be subjected to the operational test at manufacturer’s works of Nitrogen Injection Fire Prevention & Extinguishing System in presence of RSDCL’s representative. The manufacturer’s test certificate of various accessories of Nitrogen Injection Fire Prevention & Extinguishing System shall be furnished at the time of inspection to the inspecting officer.

1.26.6: DISPATCH CLEARANCE/ INSTRUCTIONS:

The dispatch clearance/ instructions of satisfactorily inspected transformer can be issued subject to withholding 15% of payable cost of transformer, if compliance of any one of or all of the following is not received from the supplier/bidder.

(a) Test report from CPRI/ERDA for the composite oil sample drawn from the oil drums for testing as per IS: 335 and specification.
(b) Test report from CPRI/ERDA for oil sample drawn from transformer tank for Dissolved Gas Analysis before and after Temp. rise test.
(c) Test report from Govt./ Govt. approved/ Govt. recognized/NABL accredited lab for the core material sample drawn during stage inspection of core building for measurement of specific losses at 1.6 tesla, magnetization characteristics and thickness.

The above 15% withheld payment shall be made after receipt of satisfactory test reports (original) as above.

1.26.7: The supplier shall provide the manufacturer’s routine test certificate for bought out items to the Inspecting Officer during inspection.

1.27: TESTS AT SITE:

After erection at site, all the Transformers shall be subjected to the following tests:

(i) Insulation resistance test.
(ii) Ratio and polarity test.
(iii) Dielectric test on oil.
(iv) Measurement of excitation current at low voltage (AC) energisation of HV & LV winding. The applied voltage will correspond to AC voltage used during corresponding factory tests.
(v) Measurement of Capacitance and Tan delta of transformer winding and each bushing.
(vi) Measurement of winding resistance of each winding.
(vii) SFRA test.

In case the equipment is not found as per the requirements of the purchase order, all expenses incurred during site testing will be to the bidder’s account and the material shall be replaced by him at site, free of cost.

1.28: FURTHER TESTS:

The purchaser reserves the right of having other reasonable tests carried out at his own expenses either before dispatch or during performance guarantee period from Govt./ Govt. approved/ Govt. recognized test lab to ensure that the transformer complies with the requirements of this specification after due intimation to the bidder/supplier. In case, equipment is not found meeting the requirement of purchase order/specification, all expenses incurred for such testing will be to bidder’s/supplier’s account and the material shall be replaced by supplier at site free of cost.

1.29: TEST REPORTS: After all tests have been completed, three certified copies of each test report shall be furnished. Each report shall supply the following information (One set of the test reports shall be supplied to consignee along with dispatch documents).

(i) Complete identification data including serial number of the transformer.
(ii) Method of application, where applied duration and interpretation of results for each test.
(iii) Temperature data corrected to 75 degree C including ambient temperature.

1.30: FREQUENCY AND SYSTEM VOLTAGE:

The transformer shall be suitable for continuous operation with a frequency variation of +/- 3% from normal of 50 cycles per second without exceeding the specified temperature rise. The highest system rated voltage shall be 245 KV for HV and 36 KV for LV. However, the flux density requirements shall be as per clause 1.15.8.

1.31: DATA FOR OVER FLUXING RELAY:

The purchaser intends to employ over fluxing having following characteristic:

<table>
<thead>
<tr>
<th>V/F</th>
<th>1.01</th>
<th>1.05</th>
<th>1.10</th>
<th>1.15</th>
<th>1.20</th>
<th>1.25</th>
<th>1.30 (K1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T in sec.</td>
<td>605</td>
<td>149</td>
<td>55</td>
<td>24.7</td>
<td>9.3</td>
<td>5.8</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Further, to protect transformer under severe over fluxing conditions, a high set unit is also provided with setting range from 1.0 to 1.5 times the setting of K1. The typical operating time of this high set unit shall be 125 m.sec. at 1.3 times setting. It is desirable that transformer saturation characteristics are matched with relay characteristic so as to provide adequate protection to transformer while operating in the system. The manufacturer shall recommend relay setting and/or make/characteristic of any other over fluxing relay if so selected to protect the transformer from failure due to the over fluxing. The manufacturer however shall also furnish calculation for temperature rise of core due to over fluxing for one minute and for five seconds durations respectively for 125% and 140% over fluxing withstand capability of core insulation.
1.32: NOISE & VIBRATION:

1.32.1: The transformers and accessories shall be designed, manufactured and assembled so that vibration effect is the least and the transformer can withstand the vibration that occur during the expected life of the transformer without damage.

1.32.2: The transformer and its fans shall be so designed that the average sound level will not exceed values specified in the latest revision of NEMA standard TR-1 when measured in factory, in accordance with the conditions outlined in the standard.

1.32.3: All accessories or controlled equipment which are to be mounted in a Control Room, remote from the transformer installation and those to be furnished by the bidder shall not generate objectionable noise over the permissible voltage range.

1.33: DRAWINGS:

1.33.1: The drawings and the technical literature list below shall be submitted by the bidder:

(i) General outline drawing showing dimensions, quantity of insulating oil, spacing of wheel in either direction of motion, location of centre of gravity, net weight and shipping weight of transformer, tap change gear/regulating transformer, marshalling box and location of coolers, supporting structure for coolers etc.

(ii) (a) Sectional view showing the general constructional features.

(b) The drawing showing the position of various fittings.

(iii) General arrangement of foundation and structure.

(iv) Dimensions of the largest part to be shipped and the position in which it should be transported.

(v) Full details of constructions of bushing and other relevant data.

(vi) Crane requirements for assembly and dismantling of the transformer.

(vii) Technical literature on tap changer control/regulating transformer, cooling system, relays, motors and general constructional feature of winding temperature indicator, Buchholz relay, oil temperature indicator etc.

(viii) Core assembly drawing showing complete construction details and flux density calculations w.r.t. HV & LV voltage.

(ix) The Short Circuit thermal and dynamic withstands capacity calculations.

(x) Current density calculations including at lowest tap.

(xi) Type test certificates: For 220 KV transformers, bushing and OLTC and other accessories. These certificates shall not be older than 7 years as per specification.

(xii) Pert chart for manufacture and other activities from the date of placement of letter of intent to the delivery at site.

(xiii) Quality assurance plan adopted for the manufacture of the transformer. Quality assurance plan will indicate customers hold points for stage inspection within 15 days and also the test reports etc. which will be made available to inspecting officer during the stage/final inspection.

1.33.2: Within thirty days of the receipt of LOI, the bidder shall furnish, unless otherwise specified, the drawings/ particulars listed below for the approval of RSDCL:

(i) General outline drawings showing front, side elevations and plan views of the transformer and all accessories and external features with detailed dimensions, net & shipping weight, crane lift for un-tanking and for erection/ removal of bushing, size of lifting and pulling eyes, HV & LV terminal clearances, live terminal to ground clearances, quantity of insulating oil etc.

(ii) Assembly drawings of HV & LV bushings.

(iii) Control and wiring diagrams and drawings showing temperature indicator/ recorder circuits alarm circuit and control system for cooling equipment.

(iv) Drawing showing typical sectional views of the winding with details of insulation, cooling
circuit method of coil bracing and core construction along with flux density & current
density calculations.

(v) Characteristics curves of Neutral and Phase bushing current transformers.
(vi) Detailed drawings showing loading for the design of foundations for Power transformers.
(vii) Drawings showing construction and mounting details of marshalling boxes.
(viii) Drawing showing wheel loadings and centre of gravity of transformer.
(ix) Drawings giving details of name plate, terminal marking and connection diagrams.
(x) Complete arrangement of the tap changing gear with wiring circuits etc.

1.33.3: The contractor shall supply three sets of the drawings/ documents listed in 1.33.2 to the
purchaser for approval. The purchaser will review the drawings and return one copy to the
contractor within 30 calendar days after their receipt.

1.33.4: Each drawing returned by the purchaser will be appropriately stamped (a) "Generally
Approved" or (b) "Generally approved subject to observation". In case of (a), no further re-
submission of drawings shall be required for purchaser's approval. In case of (b), the
contractor shall correct his original drawings to conform to the comments made by the
purchaser and resubmit in the same manner as stated above within two weeks after the
receipt of the marked up print by him.

1.33.5: Should the contractor wish to resubmit a revision or change for approval, such
resubmission shall be in three prints. The contractor shall also supply prints of each
approval/ resubmission within 30 days of receiving the approved resubmission.

1.33.6: The contractor shall supply the purchaser, within thirty days of receiving the approved
drawings, one reproducible master plus three prints of the approved drawings per
transformer (Out of these three prints, one print shall be dispatched to consignee along
with transformer).

1.33.7: Any shop work done prior to approval of the drawing shall be at the supplier’s/
contractor’s risk. The contractor shall make all such changes in the design as are
considered necessary to make the equipment conform to the provisions and intent of this
specification without any additional cost to the purchaser.

1.33.8: Each drawing shall be identified by a drawings number and each subsequent
resubmission/ revision or addition to the drawings or procedure by revision number. All
drawings shall be thoroughly checked for accuracy and completeness and signed or
initialled by a responsible officer of the contractor.

1.33.9: Checking and approval of the drawings by the purchaser is for the benefit of the contractor
and shall not relieve the contractor of full responsibility for ensuring correct interpretation
of design drawings and specifications or for completeness and accuracy of the shop
drawings and relevant specifications.

1.33.10: The contractor shall report & incorporate only after purchaser’s approval all deviations,
concessions, omissions, changes etc. occurring thoroughly the manufacturing assembly
and testing phases and submit a complete set of “as built” drawings in reproducible forms
within 30 days of the date of the equipment is considered to be placed in satisfactory
operating condition.

1.33.11: All drawings shall be in English language and dimensions in metric system. Further, the
drawing to be furnished should be of standard size of 24” x 12” and have blank space on
lower right hand side to have a stamp of approval.
1.34: OPERATION AND MAINTENANCE/INSTRUCTION MANUALS:

1.34.1: Three (03) copies of operation, maintenance and erection manuals per transformer in English language shall be supplied one month prior to despatch of the equipment (Two of the above three sets shall be despatched along with transformer to consignee directly). The manuals shall be bound volumes and shall contain all the drawings as per clause 1.33.6 and information required for erection, operation and maintenance of the transformer. The manuals shall include amongst other, the following particulars:

(a) Marked erection prints identifying the component parts of the power transformers as despatched, with assembly drawings.
(b) Detailed dimensions, assembly and description of all components, auxiliaries etc.
(c) Detailed view of the core and winding assembly, winding connections and tapping transformer constructions etc. These drawings are required for carrying out the overhauling operation at site.
(d) List of spare parts.

1.35: ERECTION/COMMISSIONING & SUPERVISION:

1.35.1: The bidder shall furnish detailed instructions complete with drawings and leaflets to enable satisfactory erection, testing & commissioning of the equipment by the contractor. Such instructions shall reach the purchaser before the despatch of the transformer, so that there is no delay in the commencement of erection work.

1.35.2: Looking to the cost of equipment, the contractor shall arrange the commissioning of each transformer through the Engineer of manufacturer.

1.36: CLEANING AND PAINTING:

Before applying antirust primary coats, all un-galvanized parts shall be completely cleaned and shall be free from rust, scale and grease and all external rough surfaces on castings shall be filled by metal deposition. Unexposed welds need not be painted.

The interior of all transformer tanks and other oil filled chambers and internal structural steel works shall be cleaned of all scales and rust by shot or sand blasting and given anticorrosion treatment against any chances of rust. Painting material shall be heat resistant and insoluble in oil. Except for nuts, bolts and washers which shall be galvanized, all steel surfaces exposed to weather shall receive minimum of three coats of paints.

The primary coat of zinc chromate shall be applied immediately after cleaning. The second coat shall be of an oil and weather resisting nature and of a shade of colour easily distinguishable from the primary & final coats and shall be applied after the primary coat has been touched up where necessary. The final two coats shall be of glossy and oil and weather resisting non fading battle ship grey paint (Shade No. 632) on exterior and light yellow cream paint on the interior surfaces having shades as per IS:5.

Any damage to paint work incurred during transport, storing and erection shall be made good by thoroughly cleaning the damaged portion and applying the full number of coats of paint that had been applied before damage was caused. Exterior colour of paint of RTCC panel shall be as per shade 631 of IS: 5.

1.37: LABELS:

Labels shall be provided for all apparatus such as relays, switches, fuses contained in cubicles or marshalling kiosk. Descriptive labels for mounting indoor or inside cubicles and kiosks shall be of material that will ensure permanence of lettering. A matt or satin finish shall be provided to avoid dazzle from reflected light. Labels mounted on dark surfaces shall
have white lettering on a black background. Danger notices shall have red lettering on a white background. All plates shall be of a material which will not get corroded. Labelling shall be clear, consistent and adequate. Labels shall be supplied as far as possible in the following four standard sizes:

(a) Labels for fuses and links shall measure approximately 28 mm to 45 mm by 13 mm to 19 mm and lettering of 3 mm to 6 mm shall be used according to the amount of inscription required. The lettering shall have strokes of approximately 1 mm width.

(b) Labels for relays, contractors, thermal devices and similar apparatus shall measure 65 mm by 20 mm and shall have lettering as specified in (a) above.

(c) Labels for controllers and change over switches shall measure 70 mm by 30 mm and where practicable have 20 mm lettering with 1.5 mm stroke.

(d) Labels for the doors of junction boxes, marshalling kiosks and similar equipment shall measure 125 mm by wide strokes. The labels for mounting outdoors shall be weather and corrosion proof. The letters and diagrams thereon shall be formed by etching or any other such process which will ensure permanence of lettering/marking. Labels shall be attached to panels with brass screws or with steel screws which have received rust preventive treatment.

1.38: MAKES OF BOUGHT OUT ITEMS & ACCESSORIES:

1.38.1: The bought out accessories and items shall preferably be acceptable of following makes:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particular of items</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Condenser Bushing</td>
<td>CGL/ALSTOM (Areva)/BHEL/TELK/ABB.</td>
</tr>
<tr>
<td>2</td>
<td>Porcelain Bushing</td>
<td>WSI/BHEL/ CJI.</td>
</tr>
<tr>
<td>3</td>
<td>Cooling Fans</td>
<td>CGL/ALSTOM (MARATHON).</td>
</tr>
<tr>
<td>4</td>
<td>OLTC</td>
<td>EASUN-MR/BHEL/TELK/CTR.</td>
</tr>
<tr>
<td>5</td>
<td>Buchholz relay &amp; Oil, Surge Relay</td>
<td>ATVUS/PRESS &amp; FORGE/ INSTRUMENTS &amp; CONTROLS/ PRAYOG/EASUN-MR/CEDASPE ITALY/COMEM ITALY.</td>
</tr>
<tr>
<td>6</td>
<td>Terminal Connector</td>
<td>MILIND ENGINEERING/VINAYAKA/BEST &amp; CROMPTON/ NOOTAN.</td>
</tr>
<tr>
<td>7</td>
<td>Oil Preserving Equipment</td>
<td>PRONAL.</td>
</tr>
<tr>
<td>8</td>
<td>Pressure Relief Device</td>
<td>ATVUS/SUKRUT UDYOG.</td>
</tr>
<tr>
<td>9</td>
<td>OTI/WTI/MOG</td>
<td>PRESS &amp; FORGE/PRECIMEASURE/ ATVUS/SUKRUT UDYOG /PERFECT-CONTROL.</td>
</tr>
<tr>
<td>10</td>
<td>Indicating Instruments</td>
<td>AE/IMP/MECO/RISHABH.</td>
</tr>
<tr>
<td>11</td>
<td>Control Switches</td>
<td>ALSTOM/RECOM/SWITRON/KAYCEE.</td>
</tr>
<tr>
<td>12</td>
<td>Semaphore Indicator</td>
<td>ALSTOM/DAV. IND./ER.</td>
</tr>
<tr>
<td>13</td>
<td>Selector Switch</td>
<td>RECOM/SWITRON/KAYCEE.</td>
</tr>
<tr>
<td>14</td>
<td>Indicating Lamps</td>
<td>ALSTOM/TEKNIC/VAISHNO/DAV/VENSON.</td>
</tr>
<tr>
<td>15</td>
<td>Annunciator</td>
<td>INSTALARM/PROTON/MINILEC/PRADEEP/JVS/ALAN/ YASHMUN/EXPOFYN.</td>
</tr>
<tr>
<td>16</td>
<td>Contactor</td>
<td>ABB/SIEMENS/L&amp;T.</td>
</tr>
<tr>
<td>17</td>
<td>MCB</td>
<td>L&amp;T/SIEMENS/HAVELL/LEGRAND.</td>
</tr>
<tr>
<td>18</td>
<td>Rubberised cork sheet Gasket</td>
<td>ANCHOR/TALBROS/NU CORK/BHARAT CURRUB IND.</td>
</tr>
<tr>
<td>19</td>
<td>Nitrogen Injection Fire Prevention &amp; extinguishing Extinguishing System</td>
<td>CTR/SERGI.</td>
</tr>
</tbody>
</table>

111
1.38.2: However, other make of bought out items (except for OLTC, condenser bushing, Porcelain Bushing, oil preserving equipment and Nitrogen Injection Fire Prevention & Extinguishing System) shall also be acceptable, if it is of "ISI MARK" or type tested for which the bidder shall furnish attested Photostat copies of valid ISI certificate/type test reports from Govt. approved/Govt. recognized/NABL accredited test lab. The type test reports should not be older than 7 years as on the date of submission of same. However, the OLTC, condenser bushing, oil preserving equipment, Nitrogen Injection Fire Prevention & Extinguishing System and Porcelain Bushing of make other than specified above will not be acceptable.

1.39: IMPORTANT NOTES:

1) The tolerance in weight and dimensions of the transformer shall not be acceptable more than plus/minus FIVE PERCENT.

2) Make of each accessories/component shall be clearly and invariably indicated in the GTP/Bill of material. Only specific make accessories shall be indicated. The word equivalent/reputed make will not be given any consideration. Further, the accessories/bought out items shall be provided of the makes as per clause No. 1.38.

1.40: Overall Guarantee period of Transformer: The complete unit of Transformer including all accessories & fittings, to be supplied under this contract shall be guaranteed for a period of 30 Months from the date of commissioning or 36 Months from the date of supply at site whichever is earlier.
1.0 Scope

1.1 This specification covers design, engineering, manufacture, testing at manufacturer's works, delivery of 3 phase 25 MVAR 220 kV Shunt Reactors (Bus Type) and other items including all material, accessories, spares and proper transportation, handling, loading/un-loading, storage etc at site of the equipment specified.

1.2 The scope also covers the supply, erection, testing and commissioning of the above mentioned item with all accessories. The bidder shall also freely exchange any information required (such as foundation arrangements/designs, layout requirements, erection, testing and commissioning procedures for supplied equipments, field quality plans etc.) for integration of these equipments in pooling sub-stations to ensure efficient and trouble free satisfactory operation.

1.3 Type of Reactor

1.3.1 The shunt reactor shall be of either gapped core type or magnetically shielded air core type construction.

1.3.2 The impedance ratio (X0/X1) specified shall be achieved by any one of the following methods:

1.3.2.1 Adopting 5 limb core construction.

1.3.3 In case of coreless construction following requirements are stipulated.

1.3.3.1 A magnetic shield shall be provided around the coreless coils.

1.3.2.2 Non-magnetic material sheet shall form the central core to minimize the vibrations.

1.4 Reference Drawing

Reference Drawing shall be provided by RSDCL after placement of order.

1.5 Transportation

1.5.1 The Contractor shall despatch the reactor filled with oil or in an atmosphere of nitrogen or dry air at positive pressure. In the former case, the contractor shall take care of the weight limitation on transport and handling facility at site. In the latter case, necessary arrangement shall be ensured by the contractor to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. The nitrogen or dry air cylinder provided to maintain positive pressure can be taken back by the contractor after oil filling. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided. Reactor shall also be fitted with sufficient number of Electronic impact recorders (on returnable basis) during transportation to measure the movement due to impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the contractor during detailed engineering. The recording shall commence in the factory before despatch and must continue till the unit is installed on its foundation. The data of electronic impact recorder(s) shall be down loaded at site and a soft copy of it shall be handed over to Engineer-in-charge. Further, within three weeks the contractor shall communicate the interpretation of the data.

1.5.2 In case reactor is transported, nitrogen or dry air filled, the insulating oil for reactors shall be delivered at site not before 90 days from the date of commissioning, which will be informed by the Employer.
2.0 Performance

2.1 Shunt Reactors will be connected to the 220 kV transmission systems for reactive load compensation and shall be capable of controlling the dynamic over voltage occurring in the system due to load rejection. Typical line parameters of 220 kV Transmission Lines are given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Line</th>
<th>Positive sequence impedance ohms/km</th>
<th>Zero sequence impedance ohms/ km</th>
<th>Susceptance mhos/km positive</th>
<th>Susceptance mhos / km Zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>220 kV D/C Line</td>
<td>0.0265 + j0.309</td>
<td>0.263 + j1.1326</td>
<td>3.69 x 10^-6</td>
<td>2.17x10^-6</td>
</tr>
<tr>
<td>2</td>
<td>220 kV S/C Line</td>
<td>0.0264 + j0.3294</td>
<td>0.2015 + j1.095</td>
<td>3.356 x 10^-6</td>
<td>2.646x10^-6</td>
</tr>
</tbody>
</table>

2.2 Shunt Reactors shall be capable of operating continuously at a voltage 5% higher than their rated voltage without exceeding hot spot temperature of 150 deg C at any part of the reactor.

2.3 Temperature rise shall be guaranteed when shunt reactor is operating at 245 kV.

2.4 The reactors shall be subjected to switching surge overvoltage of 2.5 p.u. and temporary overvoltage of the order of 2.3 p.u. for few cycles followed by power frequency overvoltage upto 1.5 p.u. The reactor must withstand the stress due to above transient dynamic conditions which may cause additional current flow as a result of changed saturation characteristics/slope beyond 1.5 p.u. voltage.

2.5 DGA of oil shall be periodically monitored by the Employer and the interpretation of DGA results will be as per IEC-60599.

2.6 Design review

The Reactors shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric and electrical stress etc. shall be maintained during design, selection of raw material, manufacturing process etc so that the reactor(s) provide long life with least maintenance.

Design reviews shall be conducted by Employer or an appointed Consultant at different stages of the procurement process for Reactors, however the entire responsibility of design shall be with the manufacturer.

Employer may visit to the manufacturers works to inspect design, manufacturing and test facilities.

The design review will commence after placement of award with successful bidder and shall be finalised before commencement of manufacturing activity. These design reviews shall be carried out in detail to the specific design with reference of the reactor(s) under scope of this specification.

The design review shall be conducted generally following the “Guidelines for conducting design reviews for transformers 100 MVA and 132 kV and above” prepared by Cigre SC 12 Working Group 12.22.

The manufacturer will be required to demonstrate the use of adequate safety margin for thermal, mechanical, dielectric and vibration etc. design to take into the account the uncertainties of his design and manufacturing processes.
The scope of such a design review shall at least include the following:

1. Core and magnetic design
2. Winding and lead design
3. Thermal design including review of localised potentially hot area.
4. Cooling design
5. Overload capability
6. Eddy current losses
7. Seismic design, as applicable
8. Insulation co-ordination
9. Tank and accessories
9.1 Bushings and barrier design
9.2 Radiators
9.3 Sensors and protective devices – its location, fitment, securing and level of redundancy
9.4 Oil and oil preservation system
10. Corrosion protection of metallic surface and aesthetics
11. Electrical and physical Interfaces with substation
12. Earthing
13. Processing and assembly
14. Testing capabilities
15. Inspection and test plan
16. Transport and storage
17. Sensitivity of design to specified parameters
18. Acoustic Noise
19. Vibration and Tank stress
20. Spares, inter-changeability and standardization
21. Maintainability

2.7 LOSSES

As the reactor shall be in constant operation, the total loss in the reactor shall be treated for capitalization purpose, in the same way as the core loss of the transformer. Therefore, this loss shall be kept to a minimum.

2.7.1 The bidder shall indicate values of losses in KW at the rated MVAR, voltage & normal frequency. They shall indicate whether losses are firm or subject to tolerance. Ceiling for tolerance shall be indicated. If ceiling is not indicated/ specified, it will be taken as 10% for the losses.

2.7.2 Losses for evaluation of bid: For capitalization of losses and treatment of loss figures for the purpose of bid evaluation, the rate of capitalization shall be Rs.3,32,000/- per KW.

2.7.3 Liquidation damages for excessive losses: on testing, if it is found that the actual losses are more than the values quoted in the bid / specified, the undisputed liquidated damages shall be received from the contractor at the cost of losses arrived as per clause 2.7.2 above. For the fraction of a KW evaluation will be done on prorate basis.

2.7.4 Purchaser reserves the rights to reject the shunt reactor, if the losses exceed beyond tolerance limits.

3.0 Construction Details

The feature and construction of the reactors shall be in accordance with the requirements stated hereunder.
3.1 Tank and Tank Accessories

3.1.1 Tank

3.1.1.1 Tank shall preferably be of welded construction and fabricated from tested quality low carbon steel of adequate thickness. Unless otherwise approved, metal plate, bar and sections for fabrication shall comply with BS-4360 / IS 2062). The components and fitting associated with reactor are subject to Employer’s approval and design review.

3.1.1.2 All seams and those joints not required to be opened at site shall be factory welded and wherever possible they shall be double welded. After completion of tank and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members. The requirement of post weld heat treatment for tank/stress relieving shall be based on recommendation of BS-5500 table 4.4.3.1.

3.1.1.3 Tank stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.

3.1.1.4 The shunt reactor tank shall have either bolted/welded joint. In case the joint is welded it shall be provided with flange suitable for repeated welding. The joint shall be provided with a suitable gasket to prevent weld splatter inside the tank. Proper tank shielding shall be done to prevent excessive temperature rise of the joint.

3.1.1.5 Each tank shall be provided with

(a) Four symmetrically placed lifting lugs so that it will be possible to lift the complete reactor when filled with oil without structural damage to any part of the reactor. The factor of safety at any one point shall not be less than 2. The lifting lugs shall be so arranged and located as to be accessible for use when the reactor is loaded on the transport vehicle.

(b) A minimum of four jacking pads in accessible position to enable the reactor complete with oil, to be raised or lowered using mechanical/hydraulic screw jacks. Each jacking pad shall be designed to support with an adequate factor of safety for at least half of the total mass of the reactor filled with oil allowing in addition for maximum possible misalignment of the jacking force to the centre of the working surface.

(c) Suitable haulage holes.

3.1.1.6 The tank shall be designed in such a way that it can be mounted on the plinth directly.

3.1.1.7 The base of each tank shall be so designed that it shall be possible to move the complete reactor unit by skidding in any direction without injury when using plates or rails.

3.1.1.8 Paint system and procedures

The painting details for reactor main tank, pipes, conservator tank, radiator, control cabinet/marshalling box / oil storage tank etc. shall be as given below. The detailed painting procedure shall also be submitted along with the bid which shall be finalized before award of the contract. The quality of paint such that its colour should not fade during vapour phase drying process and shall be able to withstand temperature up to 120 deg C.

<table>
<thead>
<tr>
<th>Surface preparation</th>
<th>Primer coat</th>
<th>Intermediate undercoat</th>
<th>Finish coat</th>
<th>Total dry film thickness</th>
<th>Colour shade</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>Main tank, pipes, conservator or tank etc.</th>
<th>Blast cleaning Sa 2 ½*</th>
<th>Epoxy base Zinc primer (30-40µm)</th>
<th>Epoxy high build Micaceous iron oxide (HB MIO) (75µm)</th>
<th>Aliphatic polyurethane (PU) (Minimum 50µm)</th>
<th>Minimum 155µm</th>
<th>Grey shade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main tank, pipes (above 80 NB), conservator or tank</td>
<td>Blast cleaning Sa 2 ½*</td>
<td>Hot oil resistant, non-corrosive varnish or paint or</td>
<td>--</td>
<td>--</td>
<td>Minimum 30µm</td>
<td>Glossy white for paint</td>
</tr>
<tr>
<td>Radiator (external surfaces)</td>
<td>Chemical / Blast cleaning Sa 2 ½*</td>
<td>Epoxy base Zinc primer (30-40µm)</td>
<td>Epoxy base Zinc primer (30-40µm)</td>
<td>PU paint (Minimum 50µm)</td>
<td>Minimum 100µm</td>
<td>Matching shade of tank/ different shade aesthetically matching to</td>
</tr>
<tr>
<td>Radiator and pipes up to 80 NB (Internal surfaces)</td>
<td>Chemical cleaning, if required</td>
<td>Hot oil proof, low viscosity varnish and flushing with transformer oil</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Control cabinet / marshalling box</td>
<td>Seven tank process as per IS:3618 &amp; IS:6005</td>
<td>Zinc chromate primer (two coats)</td>
<td>--</td>
<td>EPOXY paint with PU top coat</td>
<td>Minimum 80µm</td>
<td>RAL 7035 shade for exterior and interior</td>
</tr>
</tbody>
</table>

Note: * indicates Sa 2 ½ as per Swedish Standard SIS 055900 of ISO 8501 Part-1.

3.1.2  **Tank Cover**

3.1.2.1  The tank cover shall be designed to prevent retention of water and shall not distort when lifted. The internal surface of the top cover shall be shaped to ensure efficient collection and direction of free gas to the buchholz relay.

3.1.2.2  At least two adequately sized inspection openings, one at each end of the tank, shall be provided for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25kg. Handles shall be provided on the inspection cover to facilitate lifting.

3.1.2.3  The tank cover shall be fitted with pockets at the position of maximum oil temperature at maximum continuous rating for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank. The thermometer shall be fitted with a captive screw to prevent the ingress of water.

3.1.2.4  Bushings, covers of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

3.1.2.5  All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over compression. Groove provided to accommodate round nitrile rubber cord for rectangular openings shall be milled. Details of all gasket joints shall be submitted for approval.
3.1.2.6 Current flowing in tank cover and bushing turrets.

To allow for the effect of possible induced and capacitive surge current, good electrical connection is maintained between the tank and turrets.

3.1.2.7 The reactor shall be provided with a 100 mm nominal diameter pipe flange with bolted blanking plate, gasket and shall be fitted at the highest point of the reactor for maintaining vacuum in the tank.

3.1.3 Axles and Wheels

3.1.3.1 The shunt reactor shall be mounted on concrete plinth foundation directly.

3.1.3.2 One complete set of flanged bi-directional wheels and axles shall be provided for each sub-station. This set of wheels and axles shall be suitable for fixing to the under carriage of shunt reactor to facilitate its movement on rail track.

3.1.3.3 The rail track gauge shall be 1676 mm. (2 Nos. across the length & 2 Nos. along the length of the Shunt Reactor tank)

3.1.3.4 Bidder shall supply one set of trolley in place of rollers for movement of shunt reactor per sub-station.

3.1.4 Foundation and Anti Earthquake clamping Device

3.1.4.1 To prevent reactor movement during earthquake, suitable a clamping device shall be provided for fixing the reactor to the foundation.

3.1.5 Conservator & Oil Preservation System

3.1.5.1 Main conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture, and shall be fitted with magnetic oil level gauge with low oil level electrically insulated alarm contacts. Magnetic oil level gauge shall be type tested. Magnetic oil level gauge and its terminal box shall conform to IP 55 degree of protection.

3.1.6 Conservator tank and pipe work

3.1.6.1 Conservator tank shall have adequate capacity between highest and lowest visible-levels to meet the requirements of expansion of total cold oil volume in the shunt reactor and cooling equipment from minimum ambient temperature to 100°C.

3.1.6.2 The conservator shall be fitted with integral lifting lugs in such a position so that it can be removed for cleaning purposes. Suitable provision shall be kept to replace air cell and cleaning of the conservator, wherever applicable.

3.1.6.3 Conservator shall be positioned so as not to obstruct any electrical connection to reactor. Pipe work shall not obstruct the opening of inspection or manhole covers.

3.1.6.4 Pipe work connections shall be of adequate size for their duty and as short and direct as possible. Only radius elbows shall be used.

3.1.6.5 The feed pipe to the reactor tank shall enter the reactor cover plate at its highest point and shall be straight for a distance not less than five times its internal diameter on the reactor side of the
Buchholz relay, and straight for not less than three times that diameter on the conservator side of the relay.

3.1.6.6 This pipe shall rise towards the oil conservator, through the Buchholz relay, at an angle of not less than 5 degree.

3.1.7 **Oil Preservation Equipment**

The requirements of air cell type oil sealing system are given below.

3.1.7.1 Contact of the oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth air cell.

3.1.7.2 The temperature of oil is likely to rise upto 100°C during operation. As such air cell used shall be suitable for operating continuously at least at 100°C.

3.1.7.3 Air cell of conservator shall be able to withstand the vacuum during installation/maintenance periods. Otherwise provision shall be kept to isolate the conservator from the main tank when the latter is under vacuum by providing a vacuum sealing valve or other suitable means in the pipe connecting main tank with the conservator.

3.1.7.4 The connection of air cell to the top of the conservator is by air proof seal preventing entrance of air into the conservator.

3.1.8 **Self Dehydrating Filter Breather**

Conservator shall be fitted with a self dehydrating maintenance free silica gel breather. It shall be so designed that:

a) Passage of air is through a dust filter and silica gel.

b) Silica gel is isolated from atmosphere by an oil seal.

c) Moisture absorption indicated by a change in color of the tinted crystals can be easily observed from a distance.

d) Breather is mounted not more than 1200 mm above rail top level.

e) To minimise the ingress of moisture following shall be provided.

i) Three breathers (of identical size) shall be connected in series for conservator of shunt reactor.

Specification for Self Dehydrating Maintenance free Silica Gel Breather are placed at Annexure-3.

3.1.9 **Pressure Relief Device**

Adequate number of pressure relief devices shall be provided at suitable locations. These shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure of reactor tank. It shall be mounted directly on the tank. One set of electrically insulated contacts shall be provided for alarm/tripping. Pressure relief device shall be properly taken through pipe and directed away from reactor/other equipment and this shall be prevented from spraying on the tank. The terminal box/boxes of PRD should conform to degree of protection as per IP-55 of IEC-60529. Following routine tests shall be conducted on PRD

a) Air pressure test

b) Liquid pressure test
c) Leakage test  
d) Contact test  
e) Dielectric test

3.1.10 Buchholz Relay

Two No. Buchholz relay required. Out of these 2 Nos. Buchholz relay, one relay should have magnetic read type contacts & the other relay should have mercury bulb type contacts. All gases evolved in the reactor shall collect in these relays. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation and taking gas sample. A copper/stainless steel tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the reactor in service. The device shall be provided with two electrically independent contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

3.1.11 Temperature Indicators

3.1.11.1 Oil Temperature Indicator (OTI)

Shunt reactor shall be provided with a 150 mm dial type thermometer for top oil temperature indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts.

The maximum reading pointer and resetting device for the thermometer shall be mounted in the marshalling box. A temperature sensing element suitably located in a pocket on top oil shall be furnished. This shall be connected to OTI by means of capillary tubing. Temperature indicator dials shall have linear gradations to clearly read at least every 2 deg C. Accuracy of OTI shall be +/-1.5% or better.

The setting of alarm and tripping contacts shall be adjustable at site and typical values are as given below which will be reviewed during detailed engineering based on manufacturer’s recommendation.

Alarm : 95°C ; Trip : 105°C

In addition to the above, the following equipment shall be provided for remote indication of oil temperature:

a) Signal transmitter

Signal transmitter shall have additional facility to transmit signal for recording oil temperature at Purchaser’s data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) standard or equivalent. The RTD may be placed in the pocket containing temperature sensing element and image coil for OTI system which will be used for both remote OTI and DAS. Necessary equipment for sending the signal to remote OTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

b) Remote oil temperature indicator

It shall be suitable for flush mounting on Purchaser’s panel. This shall not be repeater dial of local OTI and will operate by signal transmitter. Any special cable required for shielding purpose, for
connection between cooler control cabinet and remote OTI control circuit, shall be in the scope of Contractor. Only one ROTI with a four point selector switch shall be provided.

3.1.11.2 **Winding Temperature Indicator (WTI)**

A device for measuring the hot spot temperature of winding shall be provided on shunt reactors only. It shall comprise the following:

(i) Temperature sensing element  
(ii) Image coil  
(iii) Auxiliary current transformers if required to match the image coil shall be furnished and mounted in the marshalling box.  
(iv) 150 mm dia local indicating instrument with maximum reading pointer mounted in marshalling box and with two adjustable, electrical independent, ungrounded contacts, one for high winding temperature alarm and one for trip. Temperature indicator dial shall have linear gradations to clearly read at least every 2 deg C.  
(v) Calibration device.  
(vi) Accuracy of WTI shall be +/-1.5% or better.

The setting of alarm and tripping contacts shall be adjustable at site and typical values are as given below which will be reviewed during detailed engineering based on manufacturer’s recommendation.

Alarm : 110°C; Trip : 120°C

(vii) In addition to the above, the following shall be provided for remote indication of winding temperature for each reactor.

(a) Signal Transmitter  

Signal Transmitter shall have additional facility to transmit signal for recording winding temperature at Purchaser’s data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied.

The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) or equivalent standard. The RTD may be placed in the pocket containing temperature sensing element and image coil for WTI system which will be used for both remote WTI and DAS. Necessary equipment for sending the signal to remote WTI and DAS shall be provided. In lieu, separate RTD for each of these functions shall be provided.

b) Remote Winding temperature indicator  

Remote winding temperature indicator shall be suitable for flush mounting on Purchaser’s panel. This shall not be repeater dial of local WTI and will operate by signal transmitter. Any special cable required for shielding purpose, for connection between Marshalling box and remote WTI control circuit, shall be in the scope of Contractor. Drawing showing the mounting details of RWTI shall be submitted to the Purchaser.

3.1.12 **Earthing Terminals**

3.1.12.1 Two (2) earthing pads (each complete with two (2) nos. holes, M 10 bolts, plain and spring washers) suitable for connection to 75 x 12 mm galvanised steel grounding flat shall be provided each at position close to earth of the two (2) diagonally opposite bottom corners of the tank.
3.1.12.2 Two earthing terminals suitable for connection to 75 x 12 mm galvanised steel flat shall also be provided on cooler, marshalling box and any other equipment mounted separately.

3.2 Core

3.2.1 In case of gapped core construction the following requirements are stipulated.

3.2.1.1 The core shall be constructed from high grade, non-ageing, cold rolled, super grain oriented, silicon steel laminations.

3.2.1.2 The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations which may cause local heating.

3.2.1.3 The insulation of core to bolts and core to clamp plates shall be able to withstand a voltage of 2 kV rms for 1 minute.

3.2.1.4 Core and winding shall be capable of withstanding the shocks during transport, installation and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

3.2.1.5 All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

3.2.1.6 When bell type tank construction is offered, suitable projecting guides shall be provided on core assembly to facilitate removal of tank.

3.2.1.7 Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.

3.2.1.8 The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of the tank through drain valve or cause trapping of air during oil filling.

3.2.1.9 Adequate lifting lugs as required shall be provided to enable lifting of the core and winding.

3.3 Windings

3.3.1 The Contractor shall ensure that windings of reactors are made in dust proof and conditioned atmosphere.

3.3.2 The conductors shall be of electrolytic grade copper, free from scales and burrs.

3.3.3 The insulation of windings and connections shall be free from insulating components which are liable to soften, ooze out, shrink or collapse shall and be non-catalytic and chemically inactive in oil during service.

3.3.4 Coil assembly and insulating spacer shall be so arranged as to ensure free circulation of oil and to reduce the hot spots of the winding.

3.3.5 Coil shall be made up, shaped and braced to provide for expansion and contraction due to temperature changes.
3.3.6 The conductors shall be transposed at sufficient intervals in order to minimise eddy currents and to equalise the distribution of currents and temperature along the winding.

3.3.7 Fiber optic sensors shall be embedded in each phase of the winding located at hottest spot. The location and details shall be derived and indicated in the respective drawings along with justification.

3.3.8 The insulation paper shall be of high quality and the value of degree of polymerization shall not be less than 1200 P.v and the necessary test certificate shall be submitted along with the stage inspection report. Provision shall be made for taking sample of paper for testing purpose and location shall be easily accessible and indicated on the shunt reactor tank by affixing special caution plate.

3.3.9 The windings shall be done in dust free and conditioned atmosphere.

3.4 **Un-used uninhibited Insulating Oil**

3.4.1 The insulating oil shall be virgin high grade uninhibited, conforming to IEC-60296 & all parameters specified below, while tested at supplier's premises. The Supplier shall furnish test certificates from the supplier against the acceptance norms as mentioned below, prior to despatch of oil from refinery to site. Under no circumstances, poor quality oil shall be filled into the reactor and only thereafter be brought up to the specified parameter by circulation within the reactor.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>Viscosity at 100°C</td>
<td>ISO 3104 or ASTM D445 or ASTM D 7042</td>
<td>(Max.) 3 mm²/s</td>
</tr>
<tr>
<td>1b</td>
<td>Viscosity at 40°C</td>
<td></td>
<td>(Max.) 12 mm²/s</td>
</tr>
<tr>
<td>1c</td>
<td>Viscosity at -30°C</td>
<td></td>
<td>(Max.) 1800 mm²/s</td>
</tr>
<tr>
<td>2</td>
<td>Appearance</td>
<td>A representative sample of the oil shall be examined in a 100 mm thick layer, at ambient temperature</td>
<td>The oil shall be clear and bright, transparent and free from suspended matter or sediment</td>
</tr>
<tr>
<td>3</td>
<td>Pour point</td>
<td>ISO 3016 or ASTM D97</td>
<td>(Max.) -40°C</td>
</tr>
</tbody>
</table>
| 4 | Water content | IEC 60814 or ASTM D1533 | (Max.)
<p>| a) for bulk supply | 30 mg/kg |
| b) for delivery in drums | 40 mg/kg |
| 5 | Electric strength (breakdown voltage) | IEC 60156 or ASTM D1298 | (Min.) 50 kV(new unfiltered oil) / 70 kV (after treatment) |
| 6 | Density at 20°C | ISO 3675 or ISO 12185 or ASTM D 4052 | 0.820 - 0.895 g/ml |
| 7 | Dielectric dissipation factor (tan delta) at 90°C | IEC 60247 or IEC 61620 Or ASTM D924 | (Max.) 0.0025 |
| 8 | Resistivity at 90°C | IEC 60247 | 150 x 10¹² Ohm-cm (Min.) |
| 9 | Negative impulse Testing KVp @ 25°C | ASTM D-3300 | 145 (Min.) |
| 10 | Carbon type composition (% of Aromatic, Paraffins and Naphthenic compounds) | IEC 60590 or ASTM D 2140 | Max. Aromatic : 4 to 12 %, Paraffins : &lt;50% &amp; balance shall be Naphthenic compounds. |</p>
<table>
<thead>
<tr>
<th></th>
<th>Refining / Stability</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acidity</td>
<td>IEC 62021-1 or ASTM D974</td>
<td>(Max) 0.01 mg KOH/g</td>
</tr>
<tr>
<td>2</td>
<td>Interfacial tension at 27°C</td>
<td>ISO 6295 or ASTM D971</td>
<td>(Min) 0.04 N/m</td>
</tr>
<tr>
<td>3</td>
<td>Total sulfur content</td>
<td>BS 2000 part 373 or ISO 14596</td>
<td>0.15% (Max)</td>
</tr>
<tr>
<td>4</td>
<td>Corrosive sulphur</td>
<td>IEC 62535</td>
<td>Non-Corrosive on copper and paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASTM D1275B</td>
<td>Non-Corrosive</td>
</tr>
<tr>
<td>5</td>
<td>Presence of oxidation inhibitor</td>
<td>IEC 60666 or ASTM D2668 or D4768</td>
<td>0.08% (Min.) to 0.4% (Max.) Oil should contain no other additives. Supplier should declare presence of additives, if any.</td>
</tr>
<tr>
<td>6</td>
<td>2-Furfural content</td>
<td>IEC 61198 or ASTM D5837</td>
<td>25 Microgram/litre (Max.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Performance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oxidation stability</td>
<td>IEC 61125 (method c)</td>
<td>Max 0.3 mg KOH/g</td>
</tr>
<tr>
<td></td>
<td>- Total acidity</td>
<td>Test duration 500 hour IEC 60247</td>
<td>Max 0.05 %</td>
</tr>
<tr>
<td></td>
<td>- Sludge</td>
<td></td>
<td>Max 0.05</td>
</tr>
<tr>
<td></td>
<td>- Dielectric dissipation factor (tan delta) at 90°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Gassing</td>
<td>IEC 60628A or ASTM D2300</td>
<td>No general requirement</td>
</tr>
<tr>
<td>3</td>
<td>Oxidation stability (Rotating Bomb test)</td>
<td>IEC : 61125(Method B) / ASTM D2112 (e)</td>
<td>220 Minutes (Min.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Health, safety and environment (HSE)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flash point</td>
<td>ISO 2719</td>
<td>(Min.) 135°C</td>
</tr>
<tr>
<td>2</td>
<td>PCA content</td>
<td>BS 2000 Part 346</td>
<td>Max 3%</td>
</tr>
<tr>
<td>3</td>
<td>PCB content</td>
<td>IEC 61619 or ASTM D4059</td>
<td>Not detectable (Less than 2 mg/kg)</td>
</tr>
</tbody>
</table>

3.4.2  i) Prior to filling in main tank at site and shall be tested for

1. Break Down voltage (BDV) : 70kV (min.)
2. Moisture content : 30 ppm (max.)
3. Tan-delta at 90°C : Less than 0.01
4. Interfacial tension : More than 0.035 N/m

ii) Prior to energisation at site oil shall be tested for following properties & acceptance norms as per below generally in line with IS: 1866 / IEC 60422:

1. Break Down voltage (BDV) : 70 kV (min.)
2. Moisture content : 10 ppm (max.)
3. Tan-delta at 90°C : 0.01 (m ax.)
4. Resistivity at 9 °C : 6 X 10^{12} ohm-cm (min.)
5. Interfacial tension : 0.035 N/m (min.)
6. *Oxidation Stability (Test method as per IEC 61125 method C, Test duration: 500 Hrs. for inhibited oil)
a) Acidity : 0.3 (mg KOH /g) (max.)
b) Sludge : 0.05 % (max.)
c) Tan delta at 90 °C : 0.05 (max.)

7. * Total PCB content : Not detectable (2 mg/kg total)

* For S. No. 6 & 7 separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of Nigam.

3.4.3 At manufacturer's works the quality of oil used for first filling, testing and impregnation of active parts shall meet at least parameter as mentioned in Sr. No. 1 to 5 of clause 3.4.2 ii) above. The oil test results shall form part of equipment test report.

Oil sample shall be drawn before and after heat run test and shall be tested for dissolved gas analysis. Oil sampling to be done 2 hours prior to commencement of temperature rise test. Keep the pumps running for 2 hours before and after the heat run test. Take oil samples during this period. For ONAN/ONAF cooled transformer, sample shall not be taken earlier than 2 hours after shutdown.

The acceptance norms with reference to various gas generation rates shall be as per IEC 61181.

3.4.4 Oil for first filling together with 05% extra quantity to cover wastage, spillage etc. during erection, shall be supplied with the shunt reactor in non-returnable steel drums. This 05% oil quantity shall be determined by refilling the fully drained shunt reactor upto normal oil level in the conservator after the completion of the test at manufacture’s work.

3.4.5 Sufficient quantity of oil necessary for maintaining required oil level in tank, radiator and conservator etc. till completion of warranty period shall be supplied.

3.5 Terminal Arrangement

3.5.1 Bushings

3.5.1.1 The electrical and mechanical characteristics of bushings shall be in accordance with relevant IEC. Bushing must have been type tested successfully as per IEC-60137.

3.5.1.2 Bushing for various voltage rating shall be as follows

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Bushing Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 kV and above</td>
<td>Resin impregnated paper (RIP) bushing with porcelain or composite insulator. General Specification for RIP Bushing are placed at Annexure-4.</td>
</tr>
<tr>
<td>36 kV and below</td>
<td>Solid porcelain or oil communicating type. Dimensions of 36 kV bushing shall conform to IS: 3347 Part-V.</td>
</tr>
</tbody>
</table>

3.5.1.3 Oil filled condenser type bushings shall be provided with at least the following fittings:

(a) Oil level gauge
(b) Tap for capacitance/tan delta test. Test taps relying on pressure contacts against the outer earth layer of the bushing is not acceptable.

3.5.1.4 Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.

3.5.1.5 Bushings of identical rating shall be interchangeable.
3.5.1.6 Porcelain used in bushing manufacture shall be homogenous, free from laminations cavities and other flaws or imperfection that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

3.5.1.7 Clamps and fittings shall be of hot dip galvanized steel.

3.5.1.8 Bushing turret shall be provided with vent pipe, to route any gas collection through the buchholz relay.

3.5.1.9 No arcing horns shall be provided on bushings.

3.6 Terminal Marking

The terminal marking and their physical position shall be in accordance with IEC 60076.

3.7 Neutral Earthing Arrangement

3.7.1 Neutral of Reactors shall be grounded directly.

3.7.2 The neutral terminals of Reactors shall be brought to the ground level by a brass/tinned copper grounding bar, supported from the tank by using porcelain insulators. The end of the brass/tinned copper bar shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75 x 12 mm galvanised steel flats connected to Purchaser’s grounding mat.

3.8 Cooling Equipment

3.8.1 Oil immersed with natural cooling (ONAN)

3.8.1.1 The radiator bank of the shunt reactor shall be separately mounted.

3.8.1.2 Radiators shall be made from pressed steel.

3.8.1.3 Each radiator bank shall be provided with the following accessories:

(a) Top and bottom shut off valve
(b) Drain Valve and sampling valve
(c) Air release plug
(d) Two grounding terminals for termination of two (2) Nos. 75x12 mm galvanised steel flats.
(e) Thermometer pockets with captive screw caps at cooler inlet and outlet.
(f) Lifting lugs

3.8.1.4 Each radiator bank shall be detachable and shall be provided with flanged inlet and outlet branches.

3.8.1.5 Expansion joint, if required, shall be provided on top and bottom cooler pipe connection.

3.8.2 Valves

3.8.2.1 All valves upto and including 100 mm shall be of gun metal or of cast steel/ cast iron. Larger valves may be of gun metal or may have cast iron bodies. They shall be of full way type with internal screw and shall open when turned counter clock wise when facing the hand wheel.

3.8.2.2 Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.

3.8.2.3 Each valve shall be provided with the indicator to show clearly the position of the valve.
3.8.2.4 All valve flanges shall have machined faces.

3.8.2.5 All valves in oil line shall be suitable for continuous operation with shunt reactor oil at 115°C.

3.8.2.6 Gland packing/gasket material shall be of teflon rope/nitrile rubber. In case of gate/globe valves, gland packing preferably of teflon rope shall be used to prevent oil seepage through the gland.

3.8.2.7 The oil sampling point for main tank should have two identical valves to be put in series. Oil sampling valve shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.

3.8.2.8 A valve or other suitable means shall be provided to fix the on line dissolved gas monitoring system to facilitate continuous dissolved gas analysis. The location & size of the same shall be finalised during detailed engineering stage.

3.8.2.9 After testing, inside surface of all cast iron valves coming in contact with oil shall be applied with one coat of oil resisting paint/varnish. Outside surface of the valves shall be painted with two coats of red oxide zinc chromate primer followed by two coats of fully glossy finishing paint conforming to IS:2932. Outside surface except gasket seating surface of butterfly valves shall be painted with two coats of red oxide zinc chromate conforming to IS:2074 followed by two coats of fully glossy finishing paint.

3.8.2.10 All hardware used shall be cadmium plated/electro-galvanised.

3.8.2.11 For estimation purpose of spares one set of valves mean one valve of each type used in Reactor.

3.9 Marshalling Box

3.9.1 A sheet steel marshalling box of a suitable construction shall be provided for the reactor ancillary apparatus and this shall be vermin, dust & weather proof. All the terminals for remote indication shall be wired upto the marshalling box from the reactor accessories. Necessary shorting of CT secondary terminals shall be done at the marshalling box.

3.9.2 The marshalling box shall be tank mounted type. Suitable anti-vibration pads shall be provided so that vibration from tank is not transferred to the marshalling box. The marshalling box shall have sloping roof. It shall have double hinged doors and shall be provided with locking arrangement. The exterior and interior painting shall be in accordance with painting clause no 3.1.1.8.

3.9.3 All doors, removable covers and plates shall be gasketed all round with neoprene gaskets. Louvers shall have screens and filters. The screens shall be of fine wire mesh made of brass and GI wire.

3.9.4 The marshalling box shall accommodate the following:
(a) Temperature indicator for winding and oil,
(b) Terminal blocks and gland plates for incoming and outgoing cables.

3.9.5 The temperature indicator shall be so mounted that the dials are about 1200 mm above ground level. Glass doors of suitable size shall be provided for convenience of reading. A space heater and cubicle lighting with ON-OFF switch shall be provided. It shall be so designed that with the space heater switched on continuously, the temperature inside the marshalling box does not exceed the safe operating limits at the service conditions.

4.0 Fittings

4.1 The following fittings shall be provided with shunt reactor.
4.1.1 Conservator for reactor main tank with filling hole and cap, drain valve, isolating valve, vent pipe and magnetic oil level gauge with low level alarm contacts.
4.1.2 Air release devices.
4.1.3 Dehydrating breather complete with first fill of activated silicagel.
4.1.4 Inspection openings and covers.
4.1.5 Rating & diagram plate for reactors and current transformers. These plates shall be of material capable of withstanding continuous outdoor service.
4.1.6 Terminal marking plate conforming to IEC-60076.
4.1.7 Two earthing terminals each on shunt reactor tank, radiators & marshalling box etc.
4.1.8 Ladder to climb up to the reactor tank cover with suitable locking arrangement to prevent climbing during charged condition.
4.1.9 Double float/reed type Buchholz relay with alarm and trip contacts.
4.1.10 Bottom oil sampling valve and drain valves.
4.1.11 Filter valves at top and bottom.
4.1.12 Shut off valves on the pipe connection between radiator bank and reactor tank.
4.1.13 Shut off valves on both sides of Buchholz relay at accessible height.
4.1.14 Sampling gas collectors for Buchholz relay at accessible height.
4.1.15 Four jacking pads.
4.1.16 Lifting lugs or eyes for the cover.
4.1.17 Suitable terminal connectors on bushings
4.1.18 Under carriage with provision for flanged bidirectional wheels, set of flanged bidirectional wheels, set of flanged bidirectional rollers/trolley for transportation.
4.1.19 Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently.
4.1.20 Pressure relief devices with alarm/trip contacts.
4.1.21 Bushing with metal parts and gaskets to suit the termination arrangement.
4.1.22 Winding temperature indicators for local and remote mounting (only for shunt reactor).
4.1.23 Oil temperature indicator for local and remote mounting.
4.1.24 Protected type mercury or alcohol in glass thermometer.
4.1.25 Marshalling box.
4.1.26 Haulage lugs.
4.1.27 Bushing CT
4.1.28 The fittings listed above are only indicative and other fittings which generally are required for satisfactory operation of the reactor are deemed to be included.
4.1.29 One set of hand tools of reputed make packed in a carry bag/box broadly comprising of double ended spanners (open jaws, cranked ring, tubular with Tommy bar each of sizes 9mm to 24mm, one set each), adjustable wrenches (8 & 12 inch one set), gasket punches (of different sizes as used in the reactor one set), pliers (flat nose, round nose & side cutting one of each type), hammer with handle (one), files with handle (two), knife with handle (one), adjustable hacksaw (one), and cold chisel (one) shall be supplied per Substation.
4.1.30 Suitable galvanized iron tray for cabling on main tank for better aesthetics.

5.0 Inspection and Testing

The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the equipment. An indication of inspection envisaged by the Purchaser is given under Cl.5.1 below. This is however not intended to form a comprehensive programme as it is Contractor's responsibility to draw up and carry out such a programme in the form of detailed Quality Plan duly approved by Purchaser for necessary implementation.
5.1 Inspection

5.1.1 Tank and Conservator

5.1.1.1 Certification of chemical analysis and material tests of plates.
5.1.1.2 Checks for flatness.
5.1.1.3 Electrical interconnection of top and bottom tank by braided tin flexible
5.1.1.4 Welder's qualification and weld procedure.
5.1.1.5 Testing of electrodes for quality of base materials.
5.1.1.6 Inspection of major weld preparation.
5.1.1.7 Crack detection of major strength weld seams by dye penetration test.
5.1.1.8 Measurement of film thickness of
   (a) Oil insoluble varnish
   (b) Zinc chromate paint
   (c) Light grey paint
5.1.1.9 Check correct dimensions between wheels, demonstrate turning of wheels through 90°C and further dimensional check.
5.1.1.10 Check for physical properties of materials for lifting lugs, jacking pads, etc. All load bearing welds including lifting lug welds shall be subjected to non destructive test (NDT).
5.1.1.11 Leakage test of conservator.
5.1.1.12 Certification of all test results.

5.1.2 Core

5.1.2.1 Sample testing of core material for checking specific loss, bend properties, magnetisation characteristics and thickness.
5.1.2.2 Check on the quality of varnish if used on the stampings.
   (a) Measurement of thickness and hardness of varnish on stampings.
   (b) Solvent resistance test to check that varnish does not react in hot oil.
   (c) Check over-all quality of varnish on stamping, ensure uniform shining colour, no bare spots, no over burnt varnish layer and no bubbles on varnished surface.
5.1.2.3 Check on the amount of burr's.
5.1.2.4 Bow check on stampings.
5.1.2.5 Check for the overlapping stampings. Corners of the sheets are to be apart.
5.1.2.6 Visual and dimensional check during assembly stage.
5.1.2.7 Check for inter-laminar insulation between core sections after pressing.
5.1.2.8 Visual and dimensional check for straightness and roundness of core.
5.1.2.9 High voltage test (2 kV for one minute) between core and clamps.
5.1.2.10 Check of pressure during dimensional stabilisation of winding/core assembly.
5.1.2.11 Certification of all test results.

5.1.3 Insulation Material

5.1.3.1 Sample check for physical properties of material.
5.1.3.2 Check for dielectric strength.
5.1.3.3 Visual and dimensional checks.
5.1.3.4 Check for the reaction of hot oil on insulating materials.
5.1.3.5 Dimensions stability test at high temperature for insulating material.
5.1.3.6 Tracking resistance test on insulating material.
5.1.3.7 Certification of all test results.

5.1.4 Winding

5.1.4.1 Sample check on winding conductor for mechanical properties and electrical conductivity.
5.1.4.2 Visual dimensional checks on conductor for scratches, dent marks etc.
5.1.4.3 Sample check on insulating paper for pH value, electric strength.
5.1.4.4 Check for the reaction of hot oil on insulating paper.
5.1.4.5 Check for the bonding of the insulating paper on conductor.
5.1.4.6 Check and ensure that physical condition of all materials taken for winding is satisfactory and free of dust.
5.1.4.7 Check for absence of short circuit between parallel strands.
5.1.4.8 Check for brazed joints wherever applicable.
5.1.4.9 Measurement of impedance by low voltage to be carried out when core/yoke is completely restacked and all connections are ready.
5.1.4.10 Conductor-enamel test for checking of cracks, leakage and pin holes.
5.1.4.11 Conductor flexibility test.
5.1.4.12 Heat shrink test for enamelled wire.
5.1.4.13 Certification of all test results.

5.1.5 Checks before drying process

5.1.5.1 Check conditions of insulation on the conductor and between the windings.
5.1.5.2 Check insulation distance between high voltage connection cables and earth and other live parts.
5.1.5.3 Check insulation distance between low voltage connections and earth and other parts.
5.1.5.4 Insulation of core shall be tested at 2 kV/minute between core to bolts and core to clamp plates.
5.1.5.5 Check for proper cleanliness and absence of dust etc.
5.1.5.6 Certification of all test results.

5.1.6 Checks during drying process

5.1.6.1 Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
5.1.6.2 Check for completeness of drying by measuring IR and tan delta.
5.1.6.3 Certification of all test results.

5.1.7 Assembled Reactor

5.1.7.1 Check completed reactor against approved out line drawing provision for all fittings, finish level etc.
5.1.7.2 Jacking test on all the assembled reactors.
5.1.7.3 Dye penetration test shall be carried out after Jacking tests.

5.1.8 Bought Out Items

All major bought items, such as Bushing etc. shall have satisfactory performance for a period of five (5) years. The make of all bought out items shall be subject to Purchaser’s approval.

5.1.8.1 The Contractor shall also prepare a comprehensive inspection and testing programme for all bought out/ sub-contracted items and shall submit the same to the Employer for approval. Such programme shall include the following.

(a) Buchholz relay
(b) Axles and wheels/Trolley for transportation.
(c) Winding temperature indicators for local and remote mounting
(d) Oil temperature indicators for local and remote mounting
(e) Bushings
(f) Bushing current transformer
(g) Marshalling box
(h) Radiators
(i) Pressure relief device

The above list is not exhaustive and the Contractor shall also include all other bought out items in his programme.

5.2 **Factory Tests**

The manufacturer shall be fully equipped to perform all the required tests as specified. Bidder shall confirm the capabilities of the proposed manufacturing plant in this regard when submitting the bid. Any limitations shall be clearly stated.

The contractor shall bear all additional costs related to tests which are not possible to carry out at his own works.

The contractor shall submit an Inspection and test plan (ITP) for approval. A typical test plan is indicated below.

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Test Category</th>
<th>First unit *</th>
<th>Other units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Measurement of winding resistance</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>2.</td>
<td>Reactance and loss measurement</td>
<td>Routine</td>
<td>√H/C</td>
<td>√C</td>
</tr>
<tr>
<td>3.</td>
<td>Measurement of harmonic content of current</td>
<td>Type</td>
<td>√C</td>
<td>NA</td>
</tr>
<tr>
<td>4.</td>
<td>Temperature rise test</td>
<td>Type</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td>5.</td>
<td>Measurement of insulation resistance</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>6.</td>
<td>Measurement of insulation power factor and capacitance between winding and earth</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>7.</td>
<td>Lightning impulse test * <strong>with chopped on tail on all 3 windings.</strong></td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>8.</td>
<td>Switching impulse test</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>9.</td>
<td>Separate source voltage withstand test</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>10.</td>
<td>Induced overvoltage test with Partial Discharge measurement</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>11.</td>
<td>Measurement of Acoustic noise level</td>
<td>Type</td>
<td>√H/C</td>
<td>NA</td>
</tr>
<tr>
<td>12.</td>
<td>Vibration and stress measurement</td>
<td>Routine</td>
<td>√H/C</td>
<td>√C</td>
</tr>
<tr>
<td>13.</td>
<td>Gas in oil analysis</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>14.</td>
<td>Appearance, construction and dimension check</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>15.</td>
<td>Core assembly dielectric and earthing continuity</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>16.</td>
<td>Tank Vacuum test</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>17.</td>
<td>Tank Pressure test</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>18.</td>
<td>Knee point voltage measurement of Reactor</td>
<td>Type</td>
<td>√C</td>
<td>NA</td>
</tr>
<tr>
<td>19.</td>
<td>Frequency Response analysis</td>
<td>Routine</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>High voltage withstand test on Auxiliary equipment and wiring after assembly</td>
<td>Routine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------</td>
<td>--------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>21</td>
<td>Oil leakage on assembled Reactor</td>
<td>Routine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

H/C Measured in cold and hot state of temperature rise test
C Measured in cold state
* Means the first unit manufactured against the PO at each manufacturing plant

5.2.1 Routine tests on Shunt Reactor

All the routine tests listed in IEC-60289/IS-5553 (part-I) shall be carried out on each reactor and complete test report shall be submitted to purchaser after proper scrutiny and signing on each page by the test engineer of the contractor.

5.2.1.1 Switching impulse on line terminals.
5.2.1.2 Partial discharge measurement test (As per IS: 2026/IEC 60076).

Acceptance criteria

Partial discharge (PD) levels measured at the end of the 60 minute test period shall not exceed 100pC or show any rising tendency in the last 15 minutes of more than 5%. Gas evolution of DGA before and after PD test shall be interpreted in line with IEC/Cigre guidelines.

5.2.1.3 Oil leakage test on reactor tank

All tanks and oil filled compartments shall be completely filled with air or oil of a viscosity not greater than that of insulating oil conforming to IS:335 at the ambient temperature and subjected to a pressure equal to normal tank pressure plus 35 kN/sq.m (5 psi) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air during which no leakage shall occur.

5.2.1.4 Lightning impulse voltage withstand test as per relevant IEC (on all phases).
5.2.1.5 Vibration and stress measurement test.
5.2.1.6 Frequency Response Analysis (FRA).
5.2.1.7 Loss and current measurements

The load losses and load current of every reactor shall be measured as specified in IEC60076/IEC 60289. Measurements shall be also made with maximum flux conditions in the magnetic circuit. In each case the measurement shall be made at 0.90pu, 1.00pu & 1.10pu.

The following details shall be recorded and submitted with the test certificates

- The voltage readings
- The mode of response and scaling of the voltmeters
- The current reading
- The power reading
- The frequency reading
- The instrument constants and corrections
- Correction made to power and current result, due to non sinusoidal wave form of voltage and current
- The magnetisation curve of the reactor
5.2.1.8 Core assembly dielectric and earthing continuity tests
The insulation of the magnetic circuit, and between the magnetic circuit and the core clamping structure, including core-bolts, bands and/or buckles shall withstand the application of a test voltage of either 2kV AC or 3kV DC for 60 seconds.

5.2.1.9 Reactance and loss measurement

- The type tested unit shall be measured in cold and hot state.
- In other units, measurement shall be carried out in the cold state and corrected as per factors derived from type test.

5.2.1.10 Tank Tests

5.2.1.10.1 Vacuum Tests

Shunt reactor tank shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/sq.m absolute (25 torr) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

<table>
<thead>
<tr>
<th>Horizontal length of flat plate (in mm)</th>
<th>Permanent deflection (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto and including 750</td>
<td>5.0</td>
</tr>
<tr>
<td>751 to 1250</td>
<td>6.5</td>
</tr>
<tr>
<td>1251 to 1750</td>
<td>8.0</td>
</tr>
<tr>
<td>1751 to 2000</td>
<td>9.5</td>
</tr>
<tr>
<td>2001 to 2250</td>
<td>11.0</td>
</tr>
<tr>
<td>2251 to 2500</td>
<td>12.5</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>16.0</td>
</tr>
<tr>
<td>above 3000</td>
<td>19.0</td>
</tr>
</tbody>
</table>

5.2.1.10.2 Pressure Test

Shunt reactor tank of each size, its radiator, conservator vessel and other fittings together or separately shall be subjected to an air pressure corresponding to twice the normal head of oil or normal pressure plus 35KN/sq.m whichever is lower, measured at the base of the tank and maintained for one hour. The permanent deflection of the flat plate after the excess pressure has been released shall not exceed the figures specified above for vacuum test.

5.2.1.11 Measurement of capacitance and tan delta to determine capacitance between winding and earth. Tan delta value shall not be more than 0.5% corrected at 20°C. Temperature correction factor table shall be given by the Contractor and shall form the part of test results.

5.2.2 Routine tests on bushings as per IEC 60137.

5.2.3 Type tests on Shunt Reactor

Type test shall be carried out on first shunt reactor of ordered lot at manufacturing plant. All type & routine tests shall be carried out without any extra cost of purchase.

5.2.3.1 Temperature rise test (As per IEC-60289). Gas chromatographic analysis test on oil shall be conducted before and after this test. The sampling shall be in accordance with IEC-60567. For the evaluation of the gas analysis in temperature rise test, the procedure shall be as per IS: 9434 (based on IEC: 60567) and results interpreted as IS: 10593 (based on IEC-60599) /CIGRE
guidelines.

The test shall be done for a minimum of 24 hours with saturated temperature for at least 4 hours.

5.2.3.2 Measurement of zero-sequence reactance—As per IS: 2026 for 3-phase shunt reactor only.
5.2.3.3 Measurement of acoustic noise level—As per IS: 2026/IEC 60076.
5.2.3.4 Lighting impulse test on neutral—As per IS: 2026/IEC 60076.
5.2.3.5 Measurement of knee point voltage.
5.2.3.6 Degree of protection test on marshalling box as per IP-55 in accordance with IS: 13947.

5.2.4 **Type test on fittings**

All the following fittings shall conform to type tests and the type test reports shall be furnished by the contractor along with the drawings of equipment/fittings. The list of fittings and the type test requirement is:

1. Bushing (Type Test as per IS: 2099/IEC: 60137, including snap ack test)
2. Buchholz relay (Type Test as per IS: 3637 and IP-55 Test on terminal box)
3. Control cabinet (IP-55 test)
4. Pressure Relief device Test
   The pressure Relief Device of each size shall be subjected to increase in oil pressure. It shall operate before reaching the test pressure specified in reactor tank pressure test at Cl. No. 5.2.1.10.2. The operating pressure shall be recorded. The device shall seal off after excess pressure has been released.
   The terminal box / boxes of PRD should conform to degree of protection as per IP-55 of IS: 13947.
5. Magnetic Oil Level gauge & Terminal Box for IP-55 degree of protection.
6. Air Cell (Flexible air separator) – Oil side coating, Air side under Coating, Air side outer coating and coated fabric as per IS: 3400/BS: 903/IS: 7016.
7. OTI & WTI – Switch setting & operation, switch differential, switch rating.

5.2.5 **Pre-Shipment Checks at Manufacturer’s Works**

5.2.5.1 Check for inter-changeability of components of similar reactors for mounting dimensions.
5.2.5.2 Check for proper packing and preservation of accessories like radiators, bushings, dehydrating breather, rollers, buchholz relay, marshalling kiosk, connecting pipes, conservator etc.
5.2.5.3 Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.
5.2.5.4 Gas tightness test to confirm tightness.
5.2.5.5 Derivation of leakage rate and ensure the adequate reserve gas capacity.
5.2.5.6 Measure and record the dew point of nitrogen in the main tank before despatch.

6.0 **Supervision Services:**

6.1 The contractor shall arrange/provide timely supervision services of manufacture’s service engineer free of cost for all erection, testing and commissioning works of the supplied Reactors at various 220kV Pooling sub-stations.

6.2 The contractor shall also depute his expert engineer(s) alongwith technicians (if required) etc. for supervision at each stage i.e. erection, pre-commissioning testing and commissioning of supplied Reactors. He shall bring all special testing equipment, tools & tackles (as required) for these ETC
activities of supplied equipments / items.

6.3 The contractor shall submit the detailed stepwise/ activity wise procedure for receipt & storage inspections, erection, site testing and commissioning of supplied material/ items for the approval of the purchaser.

6.4 The contractor shall be responsible for deputing his expert engineer(s) as per the approved schedule.

6.5 The contractor shall submit (well in advance to approved schedule) list of the various installation and testing equipments, tools/ tackles, consumables etc. which are to be arranged by him and to be utilized during various activities/ steps of erection, testing and commissioning.

6.6 The contractor shall supervise each activity/ step as per the approved procedure/ schedule by the purchaser as per standard manufacturer’s practices.

6.7 Joint test report of each Reactor shall be prepared for the successful erection and pre-commissioning tests by contractor.

6.8 The sample inspection and site testing procedure/ programme is given below which is only for the reference and the contractor shall submit elaborated activity/ step wise procedure/ program as mentioned above for the purchasers approval.

**Sample Inspection and Site Testing Procedure/ Programme:**

The Contractor shall carry out a detailed inspection and testing programme for field activities, namely covering areas right from the receipt of material stage upto commissioning stage. A detailed programme of inspection will be available by the contractor to the purchaser. However, it is Contractor's responsibility to draw up and carryout such a programme duly approved by the Purchaser. Testing of oil sample at site shall be carried out as per Cl.3.4 above.

**6.8.1 Receipt and Storage Checks**

6.8.1.1 Check and record condition of each package, visible part of the reactors etc. for any damage.
6.8.1.2 Check and record the gas pressure in the reactor tank as well as in the cylinder.
6.8.1.3 Visual check for wedging of core and coils before filling up with oil and also check for condition of core and winding in general.
6.8.1.4 Check and record reading of impact recorders at receipt and verify the allowable limits as per manufacturer's recommendation.

**6.8.2 Installation Checks**

6.8.2.1 Check the whole assembly for tightness, general appearance etc.
6.8.2.2 Oil leakage test.
6.8.2.3 Visual check for Leakage on bushing before erection.
6.8.2.4 Measurement of capacitance and tan delta of the bushings before fixing/connecting to the reactor. Contractor shall furnish these values for site reference.
6.8.2.5 Measure and record the dew point of nitrogen in the main tank before assembly. Manufacturer shall submit dew point acceptable limits along with temperature correction factor and shall for part of instruction manual. In case dew point values are not within permissible limit suitable drying out process shall be applied for dry out of active part in consultation with the Manufacturer.
6.8.3 Commissioning Checks

6.8.3.1 Check the colour of silicagel breather.
6.8.3.2 Check the oil level in the breather housing, conservator tank, cooling system, condenser bushing etc.
6.8.3.3 Check the bushings for conformity of connection to the line etc.
6.8.3.4 Check for correct operation of all protection devices and alarms.

(a) Buchholz relay
(b) Excessive winding temperature
(c) Excessive oil temperature
(d) Low oil flow
(e) Low oil level indication

6.8.3.5 Check for adequate protection of electric circuit supplying the accessories.
6.8.3.6 Insulation resistance measurement for:

(a) Control wiring
(b) Main winding
(c) Bushing current transformer

6.8.3.7 2 kV/minute test between bushing CT terminal and earth.
6.8.3.8 Check for cleanliness of the reactor and the surrounding.
6.8.3.9 Measure vibration and noise level
6.8.3.10 DGA of oil sample just before commissioning and after 24 hours of commissioning.
6.8.3.11 Capacitance and tan delta measurement of winding & bushing.
6.8.3.12 Frequency Response Analysis (FRA). FRA equipments shall be arranged by the Purchaser.
6.8.3.13 Contractor shall prepare a comprehensive commissioning report including all commissioning test results and forward to Purchaser for future record.

6.9 --- ---- ---- ---- ---- ----

7.0 Technical Parameters

The parameters pertaining to the shunt reactor furnished under this specification are listed below:

7.1 Shunt Reactor 25 MVAR
7.1.1 Rated Voltage 245 kV (1.0pu)
7.1.2 System Fault level 40 KA
7.1.3 Connection Star with neutral brought out
7.1.4 Insulation level (for winding)

(a) Lightning impulse 1.2/50 µSec withstand voltage 1050 kVp
(b) Switching surge impulse 20/200/500 µSec voltage 750 kVp

7.1.5 Maximum temp rise over an ambient temp of 50°C and at 245 kV voltage class:

a) of winding measured by resistance method 55°C
b) of top oil measured thermometer 50°C
c) The temperature of the hottest spot shall be as per relevant standards.

7.1.6 Cooling System Natural Oil circulation (ONAN)

7.1.7 Insulation level of neutral:

(a) Impulse withstand voltage 170 kVp
(b) Power frequency voltage                    70 kV rms
(c) Whether neutral is to be brought out            Yes (through 36 kV class oil filled condenser
    bushings)

7.1.8 Ratio of zero sequence reactance to positive reactance (X0/X1) Between 0.9 & 1.0

7.1.9 Range of constant impedance Upto 1.5 pu voltage (the bidder shall furnish complete saturation characteristics of the Reactors upto 2.5 pu Voltage)

7.1.10 Tolerance on current 0 to +5% of rated current

7.1.11 Harmonic content in phase current The crest value of third harmonic component in phase current not to exceed 3% of the crest value of fundamental when reactor is energized at rated voltage with sinusoidal wave form.

7.1.12 Permissible current unbalance among different phases. + 2% of the average value

7.1.13 Minimum clearance in air:

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Phase to phase</th>
<th>Phase to ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>245 kV</td>
<td>2350 mm</td>
<td>2150 mm</td>
</tr>
<tr>
<td>36 kV</td>
<td>350 mm</td>
<td>320 mm</td>
</tr>
</tbody>
</table>

7.1.14 Noise level at rated voltage and frequency: As per NEMA-TR-1

7.1.15 Bushing (for 220 kV class Reactor)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Line side</th>
<th>Neutral side</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Rated voltage</td>
<td>245 kV</td>
<td>36 kV</td>
</tr>
<tr>
<td>(b)</td>
<td>Creepage distance (total)</td>
<td>25 mm/kV</td>
<td>25 mm/kV</td>
</tr>
<tr>
<td>(c)</td>
<td>Mounting</td>
<td>Tank cover</td>
<td>Tank cover</td>
</tr>
<tr>
<td>(d)</td>
<td>1.2/50 µSec. Lightning impulse withstand voltage (kVp)</td>
<td>1050</td>
<td>170</td>
</tr>
<tr>
<td>(e)</td>
<td>Switching impulse (250/2500 µSec.) withstand voltage (kVp)</td>
<td>750</td>
<td>-</td>
</tr>
<tr>
<td>(f)</td>
<td>One minute power frequency with stand voltage (kV rms)</td>
<td>460 kV rms</td>
<td>70 kV rms</td>
</tr>
<tr>
<td>(g)</td>
<td>Rated current (A)</td>
<td>800</td>
<td>800</td>
</tr>
</tbody>
</table>

7.1.16 Vibration and stress level Not more than 200 microns peak to peak average vibrations shall not exceed 60 microns peak to peak. Tank stresses shall not exceed 2.0kg/sq.mm at any point on the tank.

Note: All the live part to ground clearance shall be as per CBIP manual/ relevant IS/IEC.

8.0 Bushing Current Transformer

8.1 Current transformers shall comply with IS: 2705/IEC-60185.
8.2 It shall be possible to remove the turret mounted current transformers from the reactor tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents and local heat generated in the turret.

8.3 Current transformer secondary leads shall be brought out to a weather proof terminal box near each bushing. These terminals shall be wired out to cooler control cabinet/ marshalling box using separate cables for each core.

8.4 Bushing Current transformer parameters indicated in this specification are tentative and liable to change within reasonable limits. The Contractor shall obtain Purchaser's approval before proceeding with the design of bushing current transformers.

8.5 **Technical Parameters**

8.5.1 Current Transformer Parameter for 220 kV Shunt Reactor (on each phase connection)

8.5.1.1 Ratio:

<table>
<thead>
<tr>
<th></th>
<th>Line Side</th>
<th>Neutral side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core 1</td>
<td>200/1A</td>
<td>200/1A</td>
</tr>
<tr>
<td>Core 2</td>
<td>200/1A</td>
<td>1500-1200-600/1A</td>
</tr>
<tr>
<td>Core 3</td>
<td>200/1A</td>
<td>1500-1200-600/1A</td>
</tr>
<tr>
<td>Core 4</td>
<td>200/1A</td>
<td>Suitable for WTI</td>
</tr>
</tbody>
</table>

8.5.1.2 Minimum knee point voltage or burden and accuracy class: The accuracy class of WTI CT shall be one or better.

<table>
<thead>
<tr>
<th></th>
<th>Line Side</th>
<th>Neutral side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core 1</td>
<td>≥200 V Class PS</td>
<td>≥200 V Class PS</td>
</tr>
<tr>
<td>Core 2</td>
<td>≥200 V Class PS</td>
<td>Suitable for WTI being supplied</td>
</tr>
<tr>
<td>Core 3</td>
<td>≥200 V Class PS</td>
<td>1000-500 -250 V Class</td>
</tr>
<tr>
<td>Core 4</td>
<td>10 VA Class 1.0</td>
<td>1000-500 -250 V Class</td>
</tr>
</tbody>
</table>

8.5.1.3 Maximum CT Resistance:

<table>
<thead>
<tr>
<th></th>
<th>Line Side</th>
<th>Neutral side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core 1</td>
<td>1 ohm</td>
<td>1 ohm</td>
</tr>
<tr>
<td>Core 2</td>
<td>1 ohm</td>
<td>--</td>
</tr>
<tr>
<td>Core 3</td>
<td>1 ohm</td>
<td>10-5-2.5 ohm</td>
</tr>
<tr>
<td>Core 4</td>
<td>--</td>
<td>-do-</td>
</tr>
</tbody>
</table>

8.5.1.4 Application

<table>
<thead>
<tr>
<th></th>
<th>Line Side</th>
<th>Neutral side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core 1</td>
<td>Reactor Differential</td>
<td>Reactor Differential</td>
</tr>
<tr>
<td>Core 2</td>
<td>Restricted Earth fault (REF)</td>
<td>Temp. indicator (On one phase only)</td>
</tr>
<tr>
<td>Core 3</td>
<td>Reactor Backup</td>
<td>Line Protection (Main-I)/ Tzone differential Protn./spare</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>Core 4</td>
<td>Metering</td>
<td>Line Protection (Main-II)/ Tzone differential Protn./spare</td>
</tr>
</tbody>
</table>

8.6  Note :

8.6.1 The secondary excitation current of class PS shall not be more than 4% of rated secondary current at 25% of knee point voltage.
8.6.2 Accuracy class PS as per IS: 2705.
8.6.3 Class (for the relevant protection and duties) as per IEC 60185.
8.6.4 CT characteristics shall be subject to the purchaser's approval.
8.6.5 Any change in the parameters of CT required at the time of detailed engineering will have to be incorporated without any extra cost.

9. GUARANTEE PERIOD:

The guarantee period of each Reactor to be supplied under this contract shall be 30 Months from the date of commissioning or 36 Months from the date of receipt of last consignment at site, whichever is earlier.
## Annexure-1

**GUARANTEED AND OTHER TECHNICAL PARTICULARS OF 25 MVAR, 220 kV class SHUNT REACTOR**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Specification</th>
<th>GTP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>SHUNT REACTOR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Manufacture name &amp; country</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Type of reactor</td>
<td>Gapped / Air Core</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Standards applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Rated MVAR capacity at rated voltage</td>
<td>25 MVAR</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rated voltage</td>
<td>245 kV (1.0 pu)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Type of cooling</td>
<td>Natural air circulation (ONAN)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Thermal Data :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Temperature rise in oil above ambient temperature (deg.C)</td>
<td>50°C</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Temperature rise of winding by resistance above ambient temperature (Deg. C)</td>
<td>55°C</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Rated frequency (Hz)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Number of phases</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Guaranteed max, losses at rated voltage and frequency at rated output at 75 deg. C (KW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Noise level &amp; reference (db)</td>
<td>As per NEMA TR-1</td>
<td></td>
</tr>
<tr>
<td><strong>11 A</strong></td>
<td>Insulation level for Winding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Lightning impulse (1.2/50 microscopes) withstand voltage (kVp)</td>
<td>HV : 1050 kVp</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Switching surge withstand voltage (kVp)</td>
<td>HV : 750 kVp</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>One Minute power frequency withstand voltage</td>
<td>HV : 245 kVrms</td>
<td></td>
</tr>
<tr>
<td><strong>11 B</strong></td>
<td>Insulation level for Neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Impulse withstand voltage (kVp)</td>
<td>170 kVp</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Power frequency withstand voltage (kVrms)</td>
<td>70 kVrms</td>
<td></td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td>Range of voltage upto which impedance will be constant (p.u.)</td>
<td>Upto 1.5 p.u. voltage</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Impedance value at 1.3 pu (ohms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Impedance value at 1.5 pu (ohms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item No.</td>
<td>Description</td>
<td>Specification</td>
<td>GTP</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>13</td>
<td>X0 / X1</td>
<td>0.9 to 1.0</td>
<td></td>
</tr>
<tr>
<td>14. a)</td>
<td>Vibration and maximum stress on the tank</td>
<td>Not more than 200 µ Peak-Peak Average vibration shall not exceed 60 µ peak to peak. Tank stresses &lt; 2 kg/sq.mm</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Vacuum withstand capacity of tank</td>
<td>25 TORR</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Harmonic content in phase current</td>
<td>Not to exceed 3%</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Shipping weights and dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Size of largest package (mm ) x (mm) x (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Weight of largest package (Kg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Gross weight to be handled (Kg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>Gross volume to be handed (Kg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e)</td>
<td>Approx. overall dimensions (l x b x h) mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f)</td>
<td>Approx. quantity of oil required for first filling (kL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g)</td>
<td>Untanking height mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Proposed method of transportation</td>
<td>Oil/N2/Dry Air filled</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Compliance to technical specification w.r.t. parameter specified for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>Bushing CT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Bushings</td>
<td>IEC: 60137</td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>Terminal connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Whether similar equipments are type tested &amp; are in successful operation for at least two years. (If yes, furnish type test reports)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Overall General Arrangement Drawing of shunt reactor with all accessories to be enclosed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SPECIFICATION FOR SELF DEHYDRATING MAINTENANCE FREE SILICA GEL BREATHER

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>Self Dehydrating Maintenance free Silica Gel Breather</td>
</tr>
<tr>
<td>2</td>
<td>No. of tanks</td>
<td>½</td>
</tr>
<tr>
<td>3</td>
<td>Operating principal</td>
<td>1. By measurement of air moisture in the pipe with moisture sensor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. By measurement of moisture through load/ weight cell.</td>
</tr>
<tr>
<td>4</td>
<td>Material</td>
<td>All outside parts resistant to weather, transformer oil, salt water and UV</td>
</tr>
<tr>
<td>5</td>
<td>Drying Agent</td>
<td>Colourless, Non Poisonous silica gel.</td>
</tr>
<tr>
<td>6</td>
<td>Type of protection</td>
<td>IP 55 as per EN 60 529 or better.</td>
</tr>
<tr>
<td>7</td>
<td>Operating temperature range</td>
<td>0 to +80°C</td>
</tr>
<tr>
<td>8</td>
<td>Supply voltage</td>
<td>230V AC± 10% 50 Hz</td>
</tr>
<tr>
<td>9</td>
<td>Heating element insulation</td>
<td>2 KV 50 Hz, 1 min, power terminals- ground/ contacts- ground</td>
</tr>
<tr>
<td>10</td>
<td>Status indication</td>
<td>LED for Power ON, Regeneration active, LED flashing, Device error, Anti- condensation heater, Filter heater on. Self Check etc.</td>
</tr>
<tr>
<td>11</td>
<td>Analog/ Digital Output</td>
<td>4- 20mA / RS485 Serial Port.</td>
</tr>
</tbody>
</table>
## General Specification for RIP Bushing:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application:</td>
<td>Transformers</td>
</tr>
<tr>
<td>2</td>
<td>Classification:</td>
<td>Resin impregnated paper, capacitance graded, oil immersed bushing</td>
</tr>
<tr>
<td>3</td>
<td>Bushing Insulator</td>
<td>High Quality Silicone Rubber.</td>
</tr>
<tr>
<td>4</td>
<td>Altitude of site:</td>
<td>&lt;1000 m</td>
</tr>
<tr>
<td>5</td>
<td>Level of rain and humidity:</td>
<td>1-2 mm rain/min, horizontally and vertically, As per IEC 60060-1 and 5mm/min as per IEEE</td>
</tr>
<tr>
<td>6</td>
<td>Pollution level:</td>
<td>According to specified Creepage distance and IEC 60815</td>
</tr>
<tr>
<td>7</td>
<td>Immersion medium:</td>
<td>Transformer oil. Maximum daily mean oil temperature 90°C, according to IEC 60137.</td>
</tr>
<tr>
<td>8</td>
<td>Max. Pressure of medium:</td>
<td>100 KPa (over pressure)</td>
</tr>
<tr>
<td>9</td>
<td>Test tap:</td>
<td>According to IEEE potential tap type A.</td>
</tr>
<tr>
<td>10</td>
<td>Max Partial Discharge level Um</td>
<td>10pC.</td>
</tr>
<tr>
<td>11</td>
<td>Dielectric Dissipation factor tanδ (max) at PF</td>
<td>0.003</td>
</tr>
<tr>
<td>12</td>
<td>Conductor:</td>
<td>Centre tube or flexible draw lead conductor.</td>
</tr>
<tr>
<td>13</td>
<td>Markings:</td>
<td>Conforming to IEC/IEEE.</td>
</tr>
<tr>
<td>14</td>
<td>Make:</td>
<td>ABB AB Sweden, Trench China, XIAN XD High Voltage Bushing Co. Ltd. China, MASA LLC Russia, HSP Germany, ABB Switzerland Ltd., Alstom Grid SPA (Passon Villa) Itly.</td>
</tr>
<tr>
<td>15</td>
<td>Type Test.</td>
<td>As per IEC: 60137.</td>
</tr>
<tr>
<td>16</td>
<td>Type test Standard for Polymer Housing.</td>
<td>As per IEC: 61462, IEC: 60815-3.</td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATION FOR 245 KV SF6 CIRCUIT BREAKERS

1.0 SCOPE:

This specification covers the manufacture, assembly, testing at manufacturer’s works, supply/delivery & commissioning of SF6 Gas type spring operated 245KV Circuit Breakers complete with all accessories & parts (including mounting structures) required for its satisfactory operation at RSDCL Sub-stations of Nokh Solar Park (Jaisalmer).

2.0 STANDARDS:

The Circuit Breaker shall comply with the requirements of latest issue of following specifications, except where specified otherwise. Breakers meeting any other authoritative standard, which ensures an equal or better quality than the standards mentioned are also acceptable.

1. IS: 13118- Specification for circuit breaker.
2. IS: 2629 -Recommended practice for hot dip galvanizing of iron and steel.
5. IS: 2099/5621- High voltage bushing/hollow insulator.

Consideration shall also be given by the purchaser to alternative offers which supplier considers advisable by reason of his own manufacturing requirements and experience provided descriptive matter, literature and complete certificate are submitted pointing out that the equipment/devices/arrangement as offered are equal or superior to that required by the accompanying specification with full justification.

3.0 PRINCIPAL PARAMETERS:

The 245kV Circuit Breakers shall have the following ratings/principal parameters:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>245 KV CB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Number of poles</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Installation</td>
<td>Outdoor</td>
</tr>
<tr>
<td>3.</td>
<td>No. of phases</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Rated voltage</td>
<td>245 KV</td>
</tr>
<tr>
<td>5.</td>
<td>Rated frequency</td>
<td>50 C/S</td>
</tr>
<tr>
<td>6.</td>
<td>Rated normal current</td>
<td>2000 A</td>
</tr>
<tr>
<td>7.</td>
<td>Capacity to interrupt short circuit current</td>
<td>40 KA at 245 KV</td>
</tr>
<tr>
<td>8.</td>
<td>Rated duration of short circuit</td>
<td>3 seconds</td>
</tr>
<tr>
<td>9.</td>
<td>Rated line charging breaking current</td>
<td>125 A over voltage not more than 2.5 pu</td>
</tr>
<tr>
<td>10.</td>
<td>Making capacity (Peak).</td>
<td>100 KA</td>
</tr>
<tr>
<td>12.</td>
<td>Transient recovery voltage for terminal faults.</td>
<td>---- do -----</td>
</tr>
<tr>
<td>13.</td>
<td>Rated characteristics for short line faults:</td>
<td></td>
</tr>
</tbody>
</table>

(a) Standard value of TRV of supply circuit for short line faults. As Per IEC 56/1987 IEC62271-100-2001 with latest amendments, if any.
(b) Standard value of rated line characteristics for short line faults. ---- do -----.
(c) Standard value of transient recovery voltage for out of phase breaking. --- do -----.
15. Duty cycle: 0-0.3 sec-CO-3 min-CO
16. Basic insulation level: 1050 KVp
17. Total breaking time for any current: 60 ms (shorter break time shall be preferred)
   (not more than 3 cycles)
18. Difference in the instant of closing/opening of contacts:
   (a) Within a pole: Not more than 5 ms
   (b) Between poles: Not more than 10 ms
19. Rated out of phase breaking current: 10 KA
20. Frequency of operation (Mechanical): 2000 operations
21. Power frequency withstand voltage: 460 KV rms
22. No. of trip coils: 2 per pole
23. Control circuit voltage: 220 V DC
24. First pole to clear factor: 1.3
25. Clearances:
   (a) Ground clearance of lowest live terminal to ground level: 5500 mm
   (b) Min. clearance of lowest part of support insulator and ground level: 2750 mm
   (c) Inter-pole spacing: 4500 mm
   (d) Min. creepage distance of insulator bushing: 6125 mm

Any bidder offering lesser clearance than those specified above would substantiate the same with adequate information on impulse test withstand capability of equipment.

4.0 GENERAL-TECHNICAL REQUIREMENTS:

The Circuit Breakers to be offered shall be of SF6 type complete with all accessories and with mounting structures & foundation bolts, control block, Terminal Connectors, operating mechanism, copper piping, connectors, valves, marshalling box, compressors (if applicable), compressed air receivers (if applicable), gas monitoring instruments etc. complete in all respect. The breaker shall be furnished as complete unit with all piping and equipment in place and all internal wiring installed and terminated in the operating mechanism housing and the equipment shall be complete in all respect. All the individual circuit breaker poles, SF-6 monitoring devices, and interconnecting pipe lines shall be provided with valves or Self sealing couplings (DILO) at all open ends of SF-6 gas connections, so that disconnection at any end of the above does not result in the problem of leakage of SF-6 gas. Ends of interconnecting pipe lines connected to density monitor cum pressure gauge which if supplied in pre assembled condition shall not be treated as open end.

5.0 SF6 CIRCUIT BREAKERS:

5.01: SF6 Circuit Breakers shall consist of three identical single pole units each of multi-chamber design using SF6 gas in a single pressure and puffer type interrupting arrangement. The interrupting chambers of a pole shall be electrically and mechanically connected and one three phase breaker shall have three independent springs of solenoid operated devices. SF6 gas conforming to IEC-376 shall be used in the interrupting units at such a pressure that the breaker does not require any complex auxiliary circuit for pressure and temperature controls special heating system and special compressor etc., suitable gas filling and pressure monitoring arrangement alongwith safety plan shall be provided for each interrupting units separately or in common for number of breaking units of a pole or in common for all the three poles if the gas of all the poles is connected to each other.
5.02: Insulation to earth of the circuit breaker shall be independent of SF6 pressure. Suitable measures shall be adopted in the individual interrupting units to achieve requisite degree of dryness for SF6 and to absorb its decomposition products. SF6 gas filling should not develop dangerous over pressure inside the interrupting unit within the temperature rise limits to be encountered in service. SF6 gas filling in the interrupting units should work in the closed circuit without any exhaust to the open air after performing opening or closing operations. Time period in terms of number of operations at fault, number of years of normal service after which gas filling needs replacement shall be stated in the tender.

5.03: Facilities shall be provided to reduce the gas pressure within the circuit breaker to a value not exceeding 8 mili bars within 4 hours or less. Each circuit breaker shall be capable of withstanding this degree of vacuum without distortion or failure of any part. SF6 gas for first filling of each Circuit Breaker plus 20% extra in suitable non-returnable cylinders shall be included in the supply and the complete specification of the SF6 gas proposed to be utilized along with make shall be furnished to the purchaser. Bidders may supply gas of the makes other than the quoted makes in the event of non availability of the gas of quoted makes with prior approval of the purchaser. The bidder shall submit manufacturer’s test certificate of test of SF6 gas as per IEC/IS before the supply of breaker.

5.04: The high pressure cylinders in which the SF6 gas shall be supplied and stored at site shall comply with the requirements of following standards and regulations:

(i) IS:4379-Identification of the contents of Industrial Gas cylinders.
(ii) IS:7285-Seamless manganese steel cylinders for permanent and high pressure liquefiable gases.
(iii) Indian boiler regulations.

6.0 RECOVERY VOLTAGE AND POWER FACTOR:

The circuit breaker shall be capable of interrupting at its terminals rated power with recovery voltage equal to the rated maximum line to line service voltage at rated frequency and at a power factor not exceeding 0.15. Photostat copies of the type test certificates along with oscillograph records shall be submitted in support of the circuit breakers capability to interrupt rated short circuit current without undue damage. Such tests will be carried out in accordance with the latest edition of IEC-56 (IEC-62271-100-2001)/IS-13118.

The breakers shall be capable of satisfactory operation even under condition of phase opposition that may arise due to faulty synchronizing. The max. power which the breaker can satisfactorily interrupt under phase opposition shall be stated in the tender. Necessary type test certificates as per IEC-56 (IEC 62271-100-2001) and its latest amendments to prove the capability of the breaker in this regard shall be furnished by the tenderer.

7.0 LINE CHARGING CURRENT INTERRUPTING CAPACITY:

The circuit breakers shall be designed so as to be capable of interrupting line charging current without undue rise in the voltage on the supply side and without any re-strike and without showing the signs of undue strains. The guaranteed over voltage which will not be exceeded while interrupting the following currents shall be stated by the bidder. The line charging current is 125 A for 245 KV Circuit Breaker.

The over voltage caused while interrupting the above charging currents shall preferably not exceed 2.5 P.U. The results of the test conducted along with copies of the oscillographs to prove the ability of the breakers to interrupt these and lower line charging current values shall be furnished by the tenderer.
8.0 TRANSFORMER CHARGING CURRENT BREAKING CAPACITY:

The breaker shall be capable of interrupting small inductive currents such as those occurring while switching off unloaded transformers, without giving rise to undue over voltage without re-strike. Preferably, the maximum over voltage shall not be more than 2.5 P.U.

9.0 SHUNT CAPACITOR SWITCHING CAPACITY:

The maximum rating of single bank of shunt capacitors which can be switched by the circuit breakers without re-strikes shall be stated by the bidder along with over voltage occurring during such switching. The over voltage caused while interrupting the aforesaid capacitors shall not exceed 2.5 P.U.

10.0 BREAKING CAPACITY FOR KILOMETERIC FAULT:

The circuit breaker shall be capable of satisfactorily interrupting the short line faults also. Standard values or rated lines characteristics for short line faults shall be as per latest edition of IEC: 56 (IEC62271-100-2001) and test certificates shall be furnished to prove the capacity of the breaker to interrupt short line faults without any undue damage.

11.0 AUTOMATIC RAPID RECLOSING:

The circuit breaker shall be suitable for 3 pole & single pole rapid reclosing for 245KV Circuit Breakers as per schedule of requirements. The operating duty of the circuit breaker shall be as follows:

O-0.3 sec. - CO-3 min. - CO

If the dead time of the circuit breaker is adjustable, the limits of adjustment shall be stated by the bidder/supplier. Total re-closing time shall not exceed 20 cycles.

12.0 TEMPERATURE RISE:

The max. temperature attained by any part of the equipment when in service at site, under continuous full load conditions and in the climatic conditions specified in the specification shall not exceed the permissible limits fixed in the latest edition of IEC: 62271-100/IS13118 specifications. When the standards specify the limit of temperature rise, these shall not be exceeded when corrected for the difference between ambient temperature at site and the ambient temperature specified in the specifications. The correction proposed shall be stated by the tenderer and shall be subject to the approval of purchaser. In case the equipment not covered by the approved standards, the temperature rise of any part under above conditions, shall be according to IS/IEC standards.

13.0 INSULATION OF CIRCUIT BREAKER:

Insulation to ground, insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily dielectric test voltage corresponding to the basic insulation level of 1050 KVp for 245 KV breakers.

14.0 INSULATING SUPPORTS:

The basic insulation level of the external insulator supports shall be 1050 KVp for 245 KV breakers and shall be suitable for installation in normally polluted atmosphere. The porcelain used shall be homogenous and free from cavities or other flaws. They shall be designed to have ample insulation mechanical strength and rigidity for satisfactory operation under conditions specified above. All bushings of identical ratings shall be inter-changeable. The puncture strength of the bushing shall be greater than the flashover value. The bushing shall be entirely free from radio
disturbance when operating at a voltage upto 10% above rated voltage and shall also be free from external and internal corona. Make of bushings shall be WSI/ BHEL/ MODERN/ADITYA BIRLA.

15.0 OPERATING MECHANISH:

The circuit breakers shall be designed for remote control from the Control Room but provision shall also be made for local electrical control.

The operating mechanism shall be spring charging type and shall be trip-free as defined in IEC:56 (IEC62271-100-2001). The mechanism shall perform satisfactorily the reclosing duty cycles as indicated above. All working parts in the mechanism shall be of corrosion resistant material and all bearings which require greasing shall be equipped with pressure grease fittings. The mechanism shall be strong, positive quick in action and shall be removable without disturbing the other parts of the circuit breaker. The mechanism of the breaker shall be such that the failure of any spring will not prevent tripping on faults and will not cause tripping or closing, without faults. Each circuit breaker shall have mechanism open/closed indicator in addition to facilities for remote electrical indication.

The operating mechanism along with its accessories shall be mounted in a weather proof cabinet with hinged doors located near the breakers. The local control switch and the breaker position indicator shall be provided in this cabinet. The control circuit be designed to operate on 220V DC for 245KV breakers. The closing and opening coils shall be designed to operate satisfactorily at any control voltage within the limit prescribed under latest version of IEC:56 (IEC 62271-100-2001) or other relevant standard at the normal voltage. A heater shall be provided in the cabinet to prevent moisture condensation.

The Power supply for auxiliaries will be available at 415 V, 3 phase or 230V, 1-phase, 50 Cycles.

Two independent trip coils shall be provided on each breaker pole of 245KV Circuit Breakers for reliability view point. It is intended to have continuous type of pre-closing and Post closing trip circuit supervision through auxiliary relays and suitable resistors to be connected in series with each trip coil for the purpose. All the trip coils shall therefore, be designed keeping in view the above requirement.

It shall be possible to lock the circuit breaker operating apparatus box switch cubicle in the open as well as close position of the breaker.

The operating mechanism shall be trip free as per IEC: 56 (IEC62271-100-2001) and shall have anti hunting feature.

A mechanical position indicator for ON/OFF condition of the circuit breaker shall also be provided on each breaker pole or switch cubicle/apparatus box in addition to electrical or pneumatic type of indications. In case of low SF-6 gas pressure, before at blocking stage, the breaker should automatically trip and isolate the transformer/feeder. In case when any one or two of the pole/poles of the 3-Phase Circuit Breaker does/do not obey opening or closing command causing pole discrepancy, it shall be monitored by a poles discrepancy circuit which shall initiate a timer (Range 0-10 second). At the end of the pre set pole discrepancy time, tripping signal shall be given to both the trip coils of all the 3 poles so that all the poles of the circuit breaker are in open position.

16.0 APPARATUS BOX:

All the control equipments immediately connected with the operation of the circuit breaker shall be installed in an outdoor type, weather, vermin and splash proof strong cubicle having suitable number of hinged doors so as to afford easy access for all equipments mounted inside. Apparatus box shall be fabricated from heavy gauge CRCA Sheet steel of at least 3mm thick. Positive locking arrangement with lock(s) shall be provided on the front doors to check unauthorized operation. The
cubicle shall be either hot dip galvanized or synthetic enamel painted or of another approved design and construction so as to be suitable for use under tropical conditions at site. The breaker/cabinet shall contain the following equipments wherever required in addition to any other equipments required for satisfactory operation of the circuit breakers:

1. Control selector switch for local/remote electrical operation.
2. Control switch for local electrical operation.
3. Pressure switches/density monitor with alarm contacts for signaling high/low pressure.
4. Relief and drain cocks.(for pneumatic type).
5. Non return and stop valves.
6. Pressure switches for locking circuit breakers, opening closing and re-closing under low pressure.
8. Circuit breaker mechanical ON/OFF position indicator.
9. Anti pumping device.
10. Trip coils and closing coils.
11. Indicating lamps for various operations of LED type.
12. A heating element complete with a rotary switch/toggle switch.
14. MCCB/MCB/switches and fuses for controlling AC and DC supplies.
15. A power plug.
16. A light point.
17. Wiring for the cabinet.
18. Air filter (for pneumatic type).
19. Air piping and auxiliary for the cabinet (for pneumatic type).
20. A terminal board with suitable number of numbered terminals.
21. Cable glands for various power and control cables.
22. Operation Counter.
23. Rating and diagram plate in accordance with clause No. 26.0 incorporating the month and year of manufacturing.
24. Control selector switch to have either automatic spring charging arrangements or manual dependent spring charging arrangements.
25. A switch for supply to motor in case of motor operated spring charging mechanism and a motor starter with thermal O/C relay/MCB.
26. Gas density monitor.
27. Gas pressure gauge.
28. Unit air compressed system (for pneumatic type).
29. Gas feeding valve with adaptor.
30. Breaker local air receivers. (for pneumatic type)
31. The number of terminals provided shall be adequate enough to wire out all contact and control circuit plus 24 terminals spares for owner's use.
32. Any other item to complete the job. All fixtures, nuts, bolts etc. for mounting the breaker on supporting structure or on a nearby plinth. Apparatus box shall be equipped with number of cables glands for receiving PVC insulated power and control cable necessary for control and operation of circuit breakers.

17.0 AUXILIARY SWITCHES:

Each circuit breaker shall be provided with necessary number of auxiliary switches both of the normally open and normally closed types for satisfactory operation of the breaker and for operation ON/OFF indicators on the control panel. In addition 8 Nos. normally open & 8 Nos. normally closed contacts, shall also be provided with each circuit breaker as spare for various interlocking, auto re-closing schemes and remote position indication. The total number of auxiliary switches thus provided and the rating of each contact shall be clearly stated. The leads from auxiliary switch contacts shall be brought to a terminal board installed inside the auxiliary switch housing and suitable cable glands shall be provided for terminating PVC insulated control cables.
The bidder shall clearly state that whether the NO/NC contacts are of normal design or of make before break and vice versa type.

18.0 TERMINAL CONNECTORS (2000A):

Terminal connectors (Rigid type) for horizontal and vertical takeoff suitable for Twin AL-59 (Moose equivalent) Conductor for 245KV Circuit breaker shall be supplied with the circuit Breakers. Suitable terminal earth connector/suitable pads for earthing connections shall also be supplied. Supplier/Contractor shall furnish type test report for ‘STC’ and ‘Temperature rise’ tests of the Terminal Connector of the type and make offered, conducted at a Govt./Govt. approved/ Govt. recognized/NABL accredited lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory). Such type test certificate should not be older than 7 years as on the date of Technical bid opening. For this purchase, the date of conducting type test will be considered.

19.0 MOUNTING STRUCTURE:

(a) The circuit breaker shall be suitable for mounting on steel structure. The price of circuit breaker shall be quoted inclusive of mounting structure. Necessary connecting materials such as clamps, bolts, nuts washers etc. & fixing bolts for mounting the equipment on supporting structure wherever required shall also be in scope of supply. The structure shall be suitable for earth quake. Parameters for foundation & impulse withstand shall also be provided.

(b) The height of supporting structures shall be provided such that the ground clearance of lowest live terminal to ground level is available as per principal parameters specified in this specification.

(c) The plinth level of the foundation for the support structure shall be 300 mm above the ground level.

20.0 INTERLOCKS:

Necessary interlocks to prevent the closing or opening of the breakers under low pressure and devices for initiating alarm shall be provided. Provision shall also be made to enable (mechanical or electrical) interlocking with the isolator associated with the breaker to prevent the opening or closing of the isolator when the breaker is closed etc. Details of interlock provided shall be clearly stated.

21.0 INSPECTION & TESTING:

(a) 245KV SF-6 Circuit Breakers and accessories shall be subjected at maker’s works before dispatch to following routine tests/Acceptance tests as per IEC 62271-100 on 50% quantity of the offered lot for established suppliers and 100% inspection of the offered lot for un-established suppliers as per relevant standards in the presence of purchaser’s inspecting officer/representative. Moreover, supplier has to furnish the in house routine test reports for the complete offered lot with the inspection report.

(i) One minute power frequency voltage withstand dry test on main circuit.
(ii) Voltage withstand test on control & auxiliary circuit of 2 KV for 1 minute duration.
(iii) Measurement of resistance of main circuit.
(iv) Mechanical operation test.
(v) Design and visual checks.
(vi) Gas leakage test.
(vii) Tightness test (As per IEC62271-100-2001).
(b) Type tests:- The bidder/Contractor shall furnish valid and authenticated Type test certificates for following type tests from a Govt./Govt. approved/ Govt. recognized/ NABL accredited laboratory/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) of same voltage class with same operating principle and design of tendered material/equipment. Such type test certificates should not be older than 7 years as on the date of Technical bid opening. For this purpose, the date of conducting type test will be considered.

The type test certificate from in house laboratory of manufacturing firm, even if it is a Govt. approved/ Govt. recognized/ NABL accredited/ ILAC accredited lab, shall not be accepted in case of their own tender. This will not apply, if manufacturing firm is Govt. Company/ Public Sector Undertaking.

(1) Dielectric tests:
   (a) Lightning Impulse voltage test.
   (b) One minute power frequency test (wet and dry).
(2) Radio interference voltage test.
(3) Temperature rise test.
(4) Short time withstand current test.
(5) Mechanical operation test.
(6) IP-55 test (for cubicle/control cabinet).
(7) Basic short circuit test duties.
(8) Short line fault tests (L-75 & L-90).
(9) Out of phase making and breaking test.
(10) Single phase short circuit test.
(11) Capacitive current switching test.
       (a) Line charging current test.
       (b) Single capacitor bank current switching test.
(12) Seismic test.
(14) Tightness test (As per IEC62271-100-2001).
(15) EMC test, if applicable (As per IEC62271-100-2001).
(16) Any other mandatory type tests not specified above but covered as per amendment/latest edition of relevant IS/IEC.

Note:- Capacitive current switching test, if conducted as per IEC 62271-100-2001, shall be for Class C2 breakers.

(c) Tests on Bought out items:

Tests are not required to perform on bought out equipments/items like motor, CAP Unit etc at the works of manufacturer. Furnishing of test certificate of these makes from the original equipment manufacturer shall be deemed to be satisfactory evidence.

22.0 DRAWINGS, LITERATURE AND MANUALS:

The following drawings shall be supplied by the bidder/supplier:

(a) General outlines/dimensions of Circuit Breakers.
(b) Detailed drawing of breaker unit.
(c) Pneumatic/electrical connection between the breaker poles and control equipment.
(d) Apparatus box.
(e) Schedule & wiring diagram for 1/3 Phase auto-reclosing.
(f) Pneumatic/electric schematic of compressed air plant (if applicable).
(g) Terminal connector.
(h) Support structure.
23.0 METAL PARTS:

All ferrous parts of equipments shall be heavily hot dip galvanized. Bolts, nuts, screws, pins, washers etc. used in these equipments shall also be galvanized or of stainless steel. The galvanizing should conform to IS:2629-1966.

All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points, edges and sharp faces.

24.0 SPECIAL TOOLS AND PLANTS:

The manufacturer/ Contractor shall supply one set of special tools and plants (free of cost) for subsequent maintenance of the equipment offered for every three Nos. circuit breakers free of cost. The items covered in the special tools and plant shall also be mentioned.

25.0 RATING PLATE:

25.01: A circuit breaker and its operating device shall be provided with a weather and corrosion proof rating plate(s) marked with technical particulars etc. including the following:

(a) Manufacturer’s name or trade mark.
(b) S. No. of and type designation, making it possible to get all the relevant information from the manufacturer.
(c) Month and year of manufacture.
(d) Rated voltage.
(e) Rated insulation level.
(f) Rated frequency.
(g) Rated normal current.
(h) Rated short circuit breaking current.
(i) Rated duration of short circuit.
(j) First pole to clear factor.
(k) Rated auxiliary DC supply voltage of closing and opening devices.
(l) Rated pressure of SF6 for operation and interruption.
(m) Rated pressure of air/hydraulic mechanism for operation and interruption.
(n) Rated supply voltage and frequency of auxiliary circuits.
(o) Reference of PO No. & Date.
(p) Guarantee period.

25.02: The coils of operating devices shall have a reference mark permitting the data to be obtained from the manufacturer.

25.03: The rating plate shall be about 1000-1300 mm above the ground level or readable from a suitable platform which shall be provided by the manufacturer on the structure at a height not more than 750 mm from the ground level by maintaining the required electrical clearance, so that it is visible in position of normal service and installation.

26.0: Terminal blocks used shall be of 2.5 sq.mm copper control cable and should be stud (Brass) type only.

27.0: GUARANTEE PERIOD:

The guarantee period of each Circuit Breaker shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 36 KV VACUUM CIRCUIT BREAKERS

1.0 SCOPE:

This specification covers the design, manufacture, assembly, testing at manufacturer’s works before dispatch, supply and delivery at site of 3 pole, 50Hz, 36KV Vacuum Circuit breaker (VCB) of appropriate ratings for outdoor installation with supporting structure, complete with all materials and accessories for efficient and trouble free operation at RSDCL Sub-stations, Nokh (Jaisalmer).

2.0 STANDARDS:

The Vacuum circuit breaker shall conform in all respects to IS:13118 or IEC:56 (latest issue) (IEC-62271-100-2001) except in regard to the values wherever specified herein. Equipment meeting any other authoritative standard which ensure equal or better quality than the standard mentioned above will also be acceptable. In such cases, a copy of standard (English version) adopted, should be furnished. The following specifications are referred against the various equipments covered in the scope of the specification:

(II) HV Bushings/Hollow insulator: IS-2099/IS-5621.
(III) Terminal Connector: IS-5561.
(IV) Recommended practice for hot dip galvanizing of iron & steel: IS-2629.

3.0 GENERAL TECHNICAL REQUIREMENTS:

The 36KV circuit breakers offered shall have motor operated spring charged operating mechanism suitable for remote closing of the breakers. The mechanism shall be designed for electrical control from remote as well as local position. In addition local manual trip push button shall be provided in case of VCBs. The operating mechanism alongwith its accessories shall be mounted in cubicle or cabinet with front access door with lock and key, located near the breaker.

A local control switch and a breaker position indicator shall be provided in the cabinet. The breaker shall be electrically and mechanically trip free under operating conditions. 2 Nos. shunt trip coils and one No. closing coil shall be provided for the remote operation of the breaker. The control circuit for breaker shall be designed to operate on 220 Volts DC as per requirements. The studs of the breakers for outgoing/ incoming connections shall be of copper/ Aluminium Alloy. Adequate but not less than four Nos. of spare auxiliary contacts both of normally open and normally close type shall be provided on the circuit breaker for use in the remote indication and control scheme of the circuit breaker. The aux. contacts shall be preferably convertible type so that normally open contacts can be converted to normally close contact and vice versa at site. The aux. contact shall be rated 10 Amp at 240 Volts AC and 220 V DC. Cable glands for termination of multi-core control cable & power Cables shall be provided wherever required & complete bill of material for the circuit breaker including all accessories shall be furnished. The control circuit of breakers shall be designed to operate on 220 V DC.

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

4.0 PRINCIPAL PARAMETERS:

(i) Rated voltage 36 KV
(ii) Type Vacuum circuit breaker
(iii) Service. Outdoor.
(iv) Nos. of poles. 3
(v) Rated frequency. 50 Hz
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(vi) System Neutral earthing. Effectively grounded.
(vii) INSULATION LEVEL:
   (a) Impulse withstand Voltage 170 KVP
   (b) One minute power freq. voltage. 70 KV rms.
(viii) Rated Continuous Current at 2500 A & 1250 A
   50 deg. C
(ix) Short time current for 3 sec. 31.5 KA
(x) Rated breaking capacity:
   (a) Symmetrical 31.5 KA at 36 KV
   (b) Asymmetrical As per relevant standard.
(xi) Rated making capacity As per relevant standard.
   78.75 KA Peak
(xii) Total break time throughout the range of interrupting duty 5 cycles (Max.)
(xiii) Min. creepage distance 900 mm
(xiv) Spring charging Motor 230 V/415 AC
(xv) Heater/lamp/Socket 230 V AC
(xvi) Terminal Connector 2500 A & 1250 A
   (a) Type Bimetallic/Aluminum alloy suitable for both Horizontal & Vertical takeoff.
   (b) Suitable for ACSR Conductor Twin Tarantula & Single Zebra Conductors
(xvii) Auxiliary Power supply:
   (a) AC Supply 1) 415 volts, 3 ph, 4 wire, 50Hz
      2) 230 volts, 1 ph, 2 wire, 50Hz
   (b) DC Supply 220 VDC, 2 wire.
(xviii) Duty cycle 0-0.3 Sec.-CO-3Min-CO

5.0 OPERATING MECHANISM:

The operating mechanism shall be spring operated with anti pumping and trip free features, complete with shunt trip coils. All three breaker poles shall operate simultaneously. Circuit breaker shall have provision so as to be suitable for three phase auto reclosing.

The mechanism shall be designed for electrical control from remote as well as local position. In addition, local manual trip button shall be provided for VCBs. Operation counter and mechanical ON/OFF indicator shall be provided.

The operating mechanism with single or three phase motor charged independent spring closing arrangement shall be designed to withstand continuous operation throughout the life of breaker, coils without requiring any capital maintenance. Contact wear indicator/mark on operating rod shall be provided on the linkage assembly. The mechanism should be capable of performing 5000 operations without any fatigue. The interrupters shall be capable of performing 8000 to 10000 load operations. The breaker shall be provided with trip free mechanism so that tripping could over ride the closing instructions.

6.0 CLEARANCE:

The minimum height of lowest live terminal from the ground level shall be 3700 mm. The height of supporting structure shall be provided accordingly after considering the plinth level of foundation as 300 mm (max.) above ground level. The manufacturer/ Contractor offering lower height of supporting structure will likely to be ignored. The manufacturer/ Contractor shall clearly state the minimum height of lowest live parts from the ground level within the substation. Minimum Phase to Phase clearance shall be 320mm and minimum Phase to earth clearance shall be 320mm and clearly indicated in the drawings.
7.0 TEMPERATURE RISE:

The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards even at an ambient temperature of 50 Deg. C.

8.0 BUSHING/HOLLOW PORCELAIN INSULATOR:

The circuit breaker shall be fitted with weather proof capacitance graded bushing which shall be designed to have the necessary mechanical strength and rigidity required and shall be free from objectionable interference and external & internal corona. The porcelain shall be of the wet process type, homogeneous, free from laminations and cavities or other flaws which could affect its electrical or mechanical strength and shall not be injuriously stressed by temperature changes. The porcelain shall be thoroughly vitrified, tough and impervious to moisture and shall be evenly glazed. The glazing shall be free from blisters or burns. The bushings/hollow porcelain insulator shall be designed, manufactured and tested in accordance with the latest edition of IS: 2099 or BS: 223/IS-5621. The type of bushings/insulators shall be clearly specified. The bushing and hollow porcelain insulator shall be of standard make such as WSI/ BHEL/ MODERN/BIRLA NGK & shall conform to as per relevant latest IS. The make, creepage distance & creepage factor, bending load & other bushing details be clearly stated in the GTPs. Any other make quoted should be supported by relevant type test reports as per IS-5621 for hollow insulators and following test as per IS-2099 for bushings:

(a) LIV Test.
(b) HVPF (Wet) Test.

The tests should be got conducted from a Govt./Govt. approved/Govt. recognized/NABL accredited test lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab). Such type test should not be older than 7 years as on the date of opening of Technical bid for which the date of conducting of test shall be considered.

9.0 TYPE OF MOUNTING:

The circuit breaker shall be suitable for mounting on fabricated galvanized Steel structure which shall be supplied along with the breakers.

10.0 TERMINAL CONNECTORS:

2500 A & 1250 A Current (as per VCBs ratings) rating Bimetallic/Aluminum Alloy clamp type Terminal Connectors of the circuit breakers suitable for connecting ACSR Twin Tarantula & Single Zebra Conductors shall be supplied along with the Circuit Breakers. Suitable earth connectors for earthing connections shall also be supplied with the circuit breakers. The Terminal Connectors shall conform to relevant standard IS 5561. The manufacturer/Contractor shall furnish type test reports for ‘STC’ and ‘Temperature rise’ tests of the Terminal connector of the type and make offered, conducted at an independent Govt./Govt. approved/Govt. recognized/ NABL accredited lab/ ILAC i.e. International Laboratory accreditation corporation (in case of foreign laboratory) & such type test reports should not be older than 7 years as on the date of bid opening. For this purpose, the date of conducting type test will be considered.

11.0 INTERLOCK:

All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the circuit breaker shall be provided.
12.0 CONTROL CUBICLE:

A common control cubicle shall be provided with all other accessories required except those which must be located on individual poles. The protection class of cubicle shall be IP-55 of gasketed weather proof construction with adequate sealing with proper quality of adhesive or its application. Sealing arrangement should be effective and have adequate life span cubicle shall be fabricated from CRCA sheet steel min. 3 mm thick.

The cubicle shall have front access door with lock & keys and removable gland plate at the bottom for Owner’s cable entry. Thermostat controlled space heater, internal illumination lamp & 3 pin 5A socket with individual ON-OFF switches shall be provided in the cubicle. For local operation, following shall be provided:

(a) Local/Remote Selector Switch.
(b) Trip Normal Close Control Switches with pistol grip handle. All electrical & mechanical connections between the control cubicle and individual poles shall be furnished.

13.0 WIRING:

Wiring shall be complete in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

Wiring shall be done with flexible 650V grade, PVC insulated, switchboard wires with 2.5 sq.mm stranded copper conductor. Each wire shall be identified at both sides with permanent marking ferruls bearing wire numbers as per RSDCL requirement & standard wiring/ schematic diagram.

Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired upto terminal blocks in the control cubicle.

14.0 TERMINAL BLOCKS:

Terminal blocks shall be 650 V grade, box clamp type ELMEX 10 Sq.mm or approved equal. Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% of active terminals shall be furnished.

Terminal blocks shall be located to allow easy access & wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

15.0 FITTING AND ACCESSORIES:

Each circuit breaker shall be furnished complete with fittings and accessories as listed below:

- Clamp type bimetallic /aluminium alloy Terminal Connectors.
- Ground pads suitable for termination of 50x6mm flats.
- Complete mounting steel pedestal.
- Operating mechanism, double tripping coils and one closing coil.
- Auxiliary contacts and relays.
- Local/remote selector switch, trip normal close (TNC) control pistol control switch.
- Manual tripping device with protective flap.
- Mechanical ON-OFF indicator.
- Operation Counter.
- Weather proof outdoor type control cubicle and pole boxes.
- Set of switch fuse units/MCBs for AC and DC supply.
- Space heaters with thermostat and ON-OFF switch.
- Cubicle illumination lamps with ON-OFF switch.
- 3 Pin 5A socket with ON-OFF switch.
- Terminal blocks and internal wiring-lot as required.
- Set of prefabricated pipe, fittings, clamps, hardware, interconnecting, wires/cables etc for connection between control cubicle and pole boxes as may be required.
- Other standard accessories which are not specifically mentioned but are required to be supplied with breakers of similar type & rating for efficient and trouble free operation.

16.0 INSPECTION & TESTING:

(a) 36KV Circuit Breakers and accessories shall be subjected to following routine/ acceptance tests on 50% quantity of the offered lot for established suppliers and 100% quantity of the offered lot for un-established suppliers as per relevant standards in the presence of purchaser’s inspecting officer/representative. Moreover, supplier has to furnish the in house routine test reports for the complete offered lot with the inspection report:

(i) One minute power frequency voltage withstand dry test on main circuit.
(ii) Voltage withstand test on control end auxiliary circuit of 2kV for 1 minute.
(iii) Measurement of resistance of main circuit.
(iv) Mechanical operation test.
(v) Design and visual checks.

In the event of order, the manufacturer/Contractor have to get at least one breaker tested in respect of Temperature rise test in presence of purchaser representative.

(b) Type tests:

The bidder shall furnish valid and authenticated type test certificates for following type tests from a Govt./Govt. approved/ Govt. recognized/ NABL accredited laboratory/ILAC i.e. International Laboratory accreditation corporation (in case of foreign laboratory) of same voltage class with same operating principal and design of tendered material/equipment. Such type test certificates should not be older than 7 years as on the date of Technical bid opening. For this purpose, the date of conducting type test will be considered. The type test certificates from in house laboratory of tendering firm even if it is a Govt. /a Govt. approved /a Govt. recognized / NABL accredited laboratory/ ILAC accredited shall not be accepted in case of their own tender. This will not apply if tendering/manufacturing firm is Govt. Company/ Public Sector undertaking.

(1) Dielectric test:
   (a) Lightning impulse Voltage test.
   (b) One minute power frequency test (wet & dry).
(2) Temp rise test.
(3) Short time withstand current test.
(4) Mechanical operation test.
(5) IP-55 test (for cubicle/control cabinet).
(6) Basic short test duties test.
(7) Out of phase making & breaking test.
(8) Single phase short circuit test.
(9) Capacitive current switching test.
   (a) Cable charging test.
   (b) Single capacitor bank current switching test.
(10) Measurement of resistance of main circuit.
(11) Tightness test (Shall be acceptable from manufacturers as per standard practice followed).
(12) EMC test, if applicable (As per IEC62271-100-2001).
(13) Any other mandatory type test not specified above but covered as per amendments/latest addition of relevant IS/IEC.
(c) Test on bought out items: Test are not required to be performed on bought out item like motor, Insulator etc. at the works of manufacturer. Furnishing test certificate of these items from the original equipment manufacturer shall be deemed to be satisfactory evidence.

17.0 DRAWINGS & DOCUMENTS:

All relevant drawings of the Circuit Breakers, including the following shall be furnished:

(i) Outline General Arrangement drawing showing all dimensions, earthing ground pads for termination of 50x6 flat.
(ii) Schematic wiring diagram with write up.
(iii) Supporting structure drawing showing details of each member, clearances from ground etc.
(iv) Terminal connector drawing showing all dimensions.
(v) Drawing for operating mechanism box showing locking arrangement earthing etc.

18.0 RATING PLATE:

18.1: The circuit breaker and its operating device shall be provided with a weather and corrosion proof rating plate(s) marked with technical particulars etc. including the following:

(a) Manufacturer’s name or trade mark by which it may be readily identified.
(b) S. No. and type designation, making it possible to get all the relevant information from the manufacturer.
(c) Month and year of manufacture.
(d) Rated voltage.
(e) Rated insulation level.
(f) Rated frequency.
(g) Rated normal current.
(h) Rated short circuit breaking current.
(i) Rated duration of short circuit.
(j) First pole to clear factor.
(k) Rated auxiliary DC supply voltage of closing and opening devices.
(l) Rated supply voltage and frequency of auxiliary circuits.
(m) Reference of PO No. & Date.
(n) Guarantee period.

18.2: The coils of operating devices shall have a reference mark permitting the data to be obtained from the manufacturer.

18.3: The rating plate shall be about 1000-1300 mm above the ground level or readable from a suitable platform which shall be provided by the manufacturer/Contractor on the structure at a height not more than 750 mm from the ground level by maintaining the required electrical clearance, so that it is visible in position of normal service and installation.

19.0 MAKE OF VACUUM INTERRUPTER:

Vacuum interrupter shall be of standard makes such as BEL, CGL, Siemens, ABB, Alstom/Areva.

20.0 GUARANTEE PERIOD:

The guarantee period of each VCB shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment of VCBs at site, whichever is earlier.
1.0: This section covers the design, manufacture, assembly, testing at manufacturer’s work before dispatch, of single phase, 50 Hz, Oil immersed or SF6 Gas filled, self cooled, hermetically sealed out-door & Live Tank type 245 KV Current Transformers. These equipments shall be suitable for installation in system with neutral effectively grounded.

2.0 STANDARDS:

The design, manufacture and testing of various equipments covered by this specification shall comply with the latest issue of following and other applicable standards except the value wherever specified shall be considered relevant.

IS:5621: Specification for Hollow porcelain bushing.
IS:2099: Specification for Bushings.
IS:5561: Specification for Electric power connectors.
IS:10601: Dimensions of terminals for High Voltage Switchgear and Control Gear.
IS:376: Specification and acceptance for supply of Sulpher Hexafluoride.

Equipments and material conforming to alternative internationally recognized standard(s) which ensure(s) quality equal or better than the Indian standard(s) mentioned above should also be acceptable. In case the tenderer wishes to offer equipment conforming to other standard they shall furnish English Translation of the relevant standard.

3.0 245 KV CURRENT TRANSFORMERS:

3.1: The 245 KV current transformers shall be single phase, oil immersed or SF6 Gas filled, self cooled, hermetically sealed type suitable for the service conditions indicated in specification, complete in all respect and conforming to the latest standards mentioned above and modern practice of design and manufacturer.

3.2: The cores shall be high grade non-ageing, laminated silicon steel of low hysteresis losses and high permeability to ensure accuracy at both normal and over currents.

3.3: The current transformers shall be hermetically sealed to eliminate breathing and prevent air and moisture from entering the tank. The method adopted for hermetically sealing clearly be stated by the supplier. These shall be provided with oil level indicator/ sight glass with marking of maximum, normal and minimum levels for oil filled CTs or with SF6 pressure gauge for SF6 gas filled CTs and suitable pressure relieving devices capable of releasing abnormal internal pressure wherever necessary. Arrangement for oil/gas filling/drain valve/plug/ hole shall be provided to avoid leakage/pilferage of oil/SF6.

3.4: 245 KV CTs shall be ‘Live Tank’ type only.

3.4 PRINCIPAL TECHNICAL PARTICULARS OF CURRENT TRANSFORMERS:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARTICULARS</th>
<th>245 KV CTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TYPE OF CT/INSTALLATION</td>
<td>SINGLE PHASE, OIL IMMERSED OR SF6 GAS FILLED, HERMETICALLY SEALED, LIVE TANK TYPE, OUT DOOR TYPE.</td>
</tr>
<tr>
<td>2</td>
<td>TYPE OF MOUNTING</td>
<td>PEDESTAL</td>
</tr>
<tr>
<td>No.</td>
<td>SUITABLE FOR SYSTEM FREQ.</td>
<td>50 HZ</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>NOMINAL SYSTEM VOLTAGE (KV rms)</td>
<td>220</td>
</tr>
<tr>
<td>5</td>
<td>HIGHEST SYSTEM VOLTAGE (KV rms)</td>
<td>245</td>
</tr>
<tr>
<td>6</td>
<td>CURRENT RATIO (A/A)</td>
<td>500-1000/1A,5C</td>
</tr>
<tr>
<td>7</td>
<td>METHOD OF EARTHING OF SYSTEM</td>
<td>EFFECTIVELY EARTHED</td>
</tr>
<tr>
<td>8</td>
<td>RATED CONTINUOUS THERMAL CURRENT (A)</td>
<td>CT SHALL BE THERMALLY RATED FOR 200% OF MAX. PRIMARY CURRENT FOR 15 MINUTES &amp; 120% OF RATED CONTINUOUS CURRENT. HOWEVER, THE TEMPERATURE RISE TEST SHALL BE CARRIED OUT AT 120% OF RATED PRIMARY CURRENT</td>
</tr>
<tr>
<td>9</td>
<td>ACCEPTABLE LIMIT OF TEMP. RISE OVER MAX. AMBIENT TEMP. OF 50 Deg. C. FOR CONTINUOUS OPERATION AT RATED CURRENT</td>
<td>AS PER IS-2705</td>
</tr>
<tr>
<td>1</td>
<td>ACCEPTABLE PARTIAL DISCHARGE LEVEL</td>
<td>As per IEC 44-1</td>
</tr>
<tr>
<td>1</td>
<td>1.2/50 MICRO SECOND LIGHTNING IMPULSE VOLTAGE (KVP)</td>
<td>1050</td>
</tr>
<tr>
<td>2</td>
<td>ONE MINUTE DRY POWER FREQ. WITHSTAND VOLTAGE FOR PRIMARY WINDING (KV rms)</td>
<td>460</td>
</tr>
<tr>
<td>3</td>
<td>ONE MINUTE POWER FREQ. HIGH VOLTAGE WITHSTAND REQUIREMENT FOR PRIMARY WINDING (WINDING SECTION HAVING MORE THAN ONE SECTION) AND SECONDARY WINDING (KV rms)</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>TOTAL CREPGE DISTANCE OF PORCELAIN HOUSING (IN MM)</td>
<td>6125</td>
</tr>
<tr>
<td>5</td>
<td>RATED SHORT TIME WITHSTAND CURRENT FOR ONE SECOND DURATION (KA-rms)</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>RATED DYNAMIC WITHSTAND CURRENT (KAp)</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>MAX. CREPAGE FACTOR FOR HOLLOW PORCELAIN INSULATOR</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>VALUE OF TAN DELTA AT Um/√3(MAX)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### 3.5.1 Core wise details of 245 KV Current Transformers:

**Ratio 500-1000/1A, 5C (Accuracy Class 0.2):**

<table>
<thead>
<tr>
<th>No. of Cores</th>
<th>Core No.</th>
<th>Application</th>
<th>Rated burden</th>
<th>Class of Accuracy</th>
<th>Max. Instrument Security Factor</th>
<th>Min. Knee point voltage at 75 Deg. C at lowest tap</th>
<th>Max. Sec. winding resistance at 75 Deg. C at lowest ratio (Ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>Main protection-I</td>
<td>--</td>
<td>PS</td>
<td>---</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Main protection-II</td>
<td>--</td>
<td>PS</td>
<td>---</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Metering</td>
<td>10VA</td>
<td>0.2</td>
<td>5</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Protection</td>
<td>--</td>
<td>PS</td>
<td>---</td>
<td>850 V</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Bus Bar Check</td>
<td>--</td>
<td>PS</td>
<td>---</td>
<td>850 V</td>
<td>2.50</td>
</tr>
</tbody>
</table>
3.6 TEMPERATURE RISE.

The limits of temp. rise of the windings, external surface of the core and other parts of the current transformers when carrying a primary current equal to the rated continuous thermal current at the rated frequency and with rated burden shall be governed by the provisions of latest issue of IS:2705 (Pt.I). The corresponding temp. rise for the Terminal connector shall not exceed at rated continuous thermal current of the CT beyond the limits prescribed in IS:5561/1970 or latest issue.

3.7 CORES & WINDINGS:

3.7.1: The current transformers core to be used for metering and instrumentation shall be of the accuracy class as specified, the saturation factor(instrument security factor) of this core shall be low enough so as not to cause any damage to measuring instruments in the event of max. short circuits current Mu-metal or such other equivalent Ferro magnetic material shall be used for this purpose. Instrument security factor shall not exceed to 5 on all transformation ratios.

3.7.2: The current transformer cores to be used for protective relaying shall be of specified class of accuracy. The core shall be designed for min. specified knee point Voltages or max. instrument security factor of 20 as the case may be.

3.7.3: The rating of the secondary winding shall be as Specified in clause No. 3.5.0 & 3.5.1. The secondary terminals shall be brought out in a weather proof secondary terminal box fitted with a hinged/bolted door on the side of current transformer for easy access and shall be provided with short circuiting arrangement. Required transformation ratios can be achieved in any manner but the current transformers will have to satisfy the requirement of rated VA burden. Class of accuracy short time thermal current etc. in clause No. 3.5 & 3.5.1 are at all transformation ratios. The min. knee point voltage and max. secondary winding resistance shall correspond to the lowest ratio. The secondary terminal box shall be provided with necessary glands with removable gland plate for control cables. The secondary terminal box shall conform to IP-55 test.

3.7.4: Primary winding shall be made out of high conducting copper the design density for short circuit current as well conductivity for primary winding shall meet the requirement of IS:2705/1992 or its latest issue. However, for primary winding Current density corresponding to the rated short time current shall not exceed 160 Amps./Sq.mm. Suitably insulated copper wire of electrolytic grade shall be used for secondary winding. The manufacturer/bidder should furnish details of primary winding e.g. Number of primary turns, cross-section, short time current density and normal continuous rated current density in the primary winding so as to meet the requirement of relevant ISS. Windings shall have high mechanical strength for safety against short circuit stresses.

3.7.5: The shape of external metal parts shall ensure that rain water runs off and there is no stagnation.

3.7.6. The CTs shall be of robust design, tested quality and reliable in operation. Only pure high grade paper wound evenly under controlled conditions and impregnated with mineral oil under vacuum shall be used for the main insulation.

3.8 GALVANISING AND PAINTING:

All ferrous parts of 245 KV CTs exposed to atmosphere including tank and secondary terminal box shall be hot dipped galvanized as per relevant Indian Standard. Minimum thickness of sheet should be 3 mm. Welded joints have to be minimized to avoid the possibility of oil leakage. In any case welding in horizontal plane shall be avoided.

3.9 FITTINGS AND ACCESSORIES:
The CTs shall be provided with the following fittings and accessories:-

(i) 2 Nos. bimetallic terminal connectors with each CT suitable both for horizontal and vertical takeoff. The thickness of bi-metallic strip/sleeve shall be of min 2 mm.
(ii) Oil level indicator/ sight glass with marking of maximum, normal and minimum level for oil filled CTs or with SF6 pressure gauge for SF6 gas filled CTs.
(iii) Pressure release device, if design recommended.
(iv) Expansion chamber or suitable type of device for absorbing variation in volume of oil/SF6 due to change in temp. of oil/SF6.
(v) Oil/SF6 filling/ drain valve/ plug/ hole with sealing arrangement. All other required accessories/arrangement shall be provided for SF6 gas filled CTs.
(vi) Lifting lugs/holes.
(vii) Weather proof secondary terminal box fitted with hinged/bolted door and complete with terminals and short circuit arrangement. The Secondary box hinged/bolted door shall have sealing arrangement.
(viii) Two Nos. earthing terminals.
(ix) Name and rating plate, showing details of connection diagram.
(x) Test Tap for tan Delta measurement.
(xi) Caution plate for Test Tap for Tan Delta.

3.10 INSULATING OIL/SF6 GAS:

The quantity of insulating oil/SF6 gas for first filling in each current transformers and complete specification of the oil/SF6 gas shall be stated. The oil shall be EHV Grade transformer oil and conform to the requirements of latest issue of IS: 335. The SF6 gas shall confirm to the requirements of latest issue of IS:376. The Instrument Transformers shall be supplied duly filled in with EHV insulating oil/SF6 gas and shall be hermetically sealed.

3.11 BUSHINGS:

The bushing shall be of makes such as W.S.I /BHEL/MIL/BIRLA NGK/IEC only and shall conform to the relevant latest IS:5621 & IS2099. The make and catalogue No. creepage and creepage factor and other bushing details be clearly stated. Pressure of nitrogen or any other inert gas used above the oil level to permit expansion or contraction of oil alongwith device to detect any leakage if any shall also be stated. Any other make quoted should be supported by relevant type test reports as per IS-5621 and following test as per IS-2099:

(i) LIV test
(ii) HVPF(wet) test

The test should be got conducted from a Govt./Govt. approved/Govt. recognized/NABL accredited lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab), such type test certificate should not be older than 7 years as on the date of bid opening. For this purpose, the date of conducting type test will be considered.

3.12 TERMINAL CONNECTORS:

The 245 KV Current Transformers shall be supplied with bimetallic Terminal Connectors (2000A) for both ends suitable for Single/Twin AL-59 (Moose equivalent) Conductor as per requirement below and confirming to IS-5561.

245KV CURRENT TRANSFORMER: Ratio: 500-1000/1A, 5C - Single/Twin AL-59 (Moose equivalent) Conductor as per requirement. The sub-conductor spacing for Twin AL-59 (Moose equivalent) Conductor shall preferably be 300 mm.

Each Terminal Connector shall be suitable for Single/Twin AL-59 (Moose equivalent) Conductor for both horizontal and vertical takeoff arrangement. The Terminal Connector should be
suitable for withstanding the 200% of continuous max. primary current for 15 minutes. The Current transformer shall also be provided with two Nos. earthing terminals of adequate size protected against corrosion and metallically clean.

Bimetallic strips or sleeves of suitable thickness (Min. 2mm) to prevent bimetallic corrosion shall be provided as a part of the terminal connector. The bidder shall furnish valid type test report for ‘Short time Current’ and ‘Temperature rise’ tests for Terminal Connector of the type and make offered. The tests shall be got conducted at a Govt./ Govt. approved/Govt. recognized/NABL accredited lab/ ILAC i.e. International Laboratory Accreditation Cooperation(in case of foreign lab). However, the same will not be insisted, if the Terminal Connectors of make MILIND/ NOOTAN/ MEGHA /Vinayak Transmission are supplied with CTs. The type test certificates should not be older than 7 years as on the date of Technical Bid opening. For this purpose, date of conducting of type test will be considered.

3.13 NAME /RATING PLATE:

The equipments shall be provided with rating plate(s) as per relevant standards. Rating plate and terminal marking shall be as per relevant IS. Purchase order/TN reference shall also be given.

3.14 TESTS:

3.14.1: Each equipment covered under this specification shall comply with and shall be subjected to all routine/ acceptance tests prescribed in the relevant Indian Standard Specification/IEC as mentioned in Clause 2.0 as above.

3.14.2: The certified copies of tests reports from a Govt./ Govt. approved/Govt. recognized/NABL accredited lab/ ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab) of all type tests as per relevant latest standard mentioned under clause 2.0 in respect of similar equipment included in this specification alongwith bushing and terminal connector (if offered other than approved make) shall be furnished. The tenderer shall furnish/ arrange necessary calculations on the basis of STC test report furnished above to prove the CTs of offered ratios are capable to withstand the specified short circuit level. The type test certificates should not be older than 7 years as on the date of Tech. Bid opening. For this purpose, date of conducting of type test will be considered.

(A) Type test as per IS-2705 Pt-I/1992 and its latest amendments:

(a) Short time current test:

(i) On current transformer of accuracy Class 0.5
(ii) On current transformer of accuracy Class 0.5s
(iii) On current transformer of accuracy Class 0.2s

(b) Lightning impulse voltage withstand test.

(c) Temperature rise test.

(d) High voltage power frequency (wet) withstand test.

NOTE:-If the porcelain weather casing/bushing has been subjected to this test separately, the requirement of HVPF (wet)) shall be deemed to have been complied.

(B) Type test as per IEC-60044-1/1996 and its latest amendments:

(a) Chopped lightning impulse withstand test on primary winding.

(b) Radio Interference Voltage test.

(c) Temperature rise test and instrument security current test shall be carried out once on one CT of each ratio & voltage in the presence of the purchaser’s representative without any extra charges. The ISC test shall be carried out on all transformation ratios. However, one
CT of each ratio along with Terminal Connector from each lot shall be tested at 200% of the rated max. primary current for 15 minutes.

3.14.3: Following routine tests as per relevant standard shall be carried out on each equipment covered by this specification in the presence of purchaser's representative.

(A) Tests as per IS-2705 Pt-I/1992 and its latest amendments:
   (i) Verification of terminal marking and polarity.
   (ii) Power frequency dry withstand tests on primary windings.
   (iii) Power frequency dry withstand tests on secondary windings.
   (iv) Over-voltage inter-turn test.
   (v) Determination of error or other characteristics according to the requirement of the appropriate design or accuracy.

(B) Tests as per IEC-60044-1/1996 and its latest amendments:
   (i) Partial discharge tests.
   (ii) Measurement of Dielectric dissipation factor at Um/Root3.

In addition to the routine tests, all PS class CTs shall be tested in presence of Inspecting officer to prove guaranteed values of minimum knee point voltage, turn ratio test, secondary winding resistance etc. The estimated magnetization curve for PS core shall be furnished.

The routine test/acceptance test shall be conducted on 100% quantity offered for inspection.

3.15 COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usual or necessary for the equipment for its satisfactory erection/operation shall be deemed to have been included in this specification and in the scope of supply. All equipments shall be complete in all respect.

3.16 GUARANTEE PERIOD:

The guarantee period of each CT shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR OUT-DOOR TYPE 36KV CURRENT AND POTENTIAL TRANSFORMERS

1.0: This section covers the design, manufacture, assembly, testing at manufacturer’s work before dispatch, of single phase, 50 Hz. Oil immersed, self cooled, hermetically sealed outdoor type 36KV Current Transformers & 36KV Potential Transformers. These equipments shall be suitable for installation in system with neutral effectively grounded.

2.0 STANDARDS:

The design, manufacture and testing of various equipments covered by this specification shall comply with the latest issue of following and other applicable standards except the value wherever specified shall be considered relevant.

IS:2705 - Specification for current transformers.
IS:5621 - Specification for Hollow porcelain bushing.
IS:2099 - Specification for Bushings.
IS:5561 - Specification for Electric power connectors.
IS: 335 - Specification for New Insulating oils.
IS:10601- Dimensions of terminals for high Voltage Switchgear and Control Gear.
IEC-60044-1-Instrument transformers.
IS-3156 - Specification for voltage transformers.
IS-4056 - Application Guide for voltage transformers.

3.0 36 KV CURRENT TRANSFORMERS:

3.1: The 36 KV Current Transformers shall be single phase, oil immersed, self cooled, hermetically sealed type suitable for the service conditions indicated, complete in all respect and conforming to the latest standards mentioned above and modern practice of design and manufacturer.

3.2: The cores shall be high grade non-ageing, laminated silicon steel of low hysteresis losses and high permeability to ensure accuracy at both normal and over current.

3.3: The Current Transformers shall be hermetically sealed to eliminate breathing and prevent air and moisture from entering the tank. The method adopted for hermetically sealing clearly be stated. The CTs shall be provided with oil level indicator/sight glass with marking of maximum, normal and minimum level and suitable pressure relieving devices capable of releasing abnormal internal pressure where ever necessary. Arrangement for oil filling/drain valve/plug/hole shall be sealed to avoid leakage/pilferage of oil.

3.4: For 36 KV CTs, only ‘Live Tank’ type design is acceptable.

3.5 PRINCIPAL TECHNICAL PARTICULARS OF 36KV CURRENT TRANSFORMERS:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARTICULARS</th>
<th>REQUIREMENTS OF 36KV CTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TYPE OF CT/INSTALLATION</td>
<td>SINGLE PHASE, LIVE TANK, OIL FILLED HERMITACALLY SEALED, OUTDOOR TYPE</td>
</tr>
<tr>
<td>2</td>
<td>TYPE OF MOUNTING</td>
<td>STEEL STRUCTURE</td>
</tr>
<tr>
<td>3</td>
<td>SUITABLE FOR SYSTEM FREQUENCY</td>
<td>50 HZ</td>
</tr>
<tr>
<td>4</td>
<td>NOMINAL SYSTEM VOLTAGE (KV rms)</td>
<td>33kV</td>
</tr>
<tr>
<td>5</td>
<td>HIGHEST SYSTEM VOLTAGE (KV rms)</td>
<td>36kV</td>
</tr>
<tr>
<td>6</td>
<td>CURRENT RATIO (A/A)</td>
<td>2400/ 1A, 4C &amp; 500-1000/1A, 2C</td>
</tr>
<tr>
<td>7</td>
<td>METHOD OF EARTHING OF SYSTEM</td>
<td>EFFECTIVELY EARTHED</td>
</tr>
<tr>
<td>8</td>
<td>RATED CONTINUOUS THERMAL</td>
<td>CT SHALL BE THERMALLY RATED FOR</td>
</tr>
<tr>
<td>No.</td>
<td>Application</td>
<td>Rated Burden</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>4</td>
<td>DIFFERENTIAL PROTECTION</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>BACK UP PROTECTION</td>
<td>40VA</td>
</tr>
<tr>
<td>3</td>
<td>METERING</td>
<td>10 VA</td>
</tr>
<tr>
<td>4</td>
<td>METERING</td>
<td>10 VA</td>
</tr>
</tbody>
</table>

(i) 36KV CT Ratio 500-1000/1A, 2C (Accuracy Class 0.2S)
3.7 CORES & WINDINGS:

3.7.1: The Current Transformers core to be used for metering and instrumentation shall be of the accuracy class as specified & the saturation factor (instrument security factor) of this core shall be low enough so as not to cause any damage to measuring instruments in the event of max. Short Circuits current. Mu-metal or such other equivalent Ferro magnetic material shall be used for this purpose. Instrument security factor shall not exceed to 5 on all transformation ratios.

3.7.2: The current transformer cores to be used for protective relaying shall be of specified class of accuracy. The core shall be designed for min. specified knee point voltages or max. accuracy limit factor of 20 as the case may be.

3.7.3: The rating of the secondary winding shall be as per clause No. 3.5.1 (i) & (ii) of this specification. The secondary terminals shall be brought out in weather proof secondary terminal box fitted with a hinged/bolted door on the side of Current Transformer for easy access and shall be provided with short circuiting arrangement. Required transformation ratios can be achieved in any manner, but the Current Transformers will have to satisfy the requirement of rated VA burden. The Class of accuracy, short time thermal current etc. as specified in clause No. 3.5 and 3.5.1 (i) & (ii) at all transformation ratios and min. knee point voltage and max. secondary winding resistance shall correspond to the lowest ratio. The secondary terminal box shall be provided with necessary glands with removable gland plate for control cables. The secondary terminal box shall conform to IP-55 test. In case of 4 core CTs, two secondary terminal boxes shall be provided i.e. one for core 1 & 2 and other for core 3 & 4 as described in core wise details of Current Transformer (clause No. 3.5.1). The secondary terminal box for core No. 3 & 4 should have arrangements for sealing also.

3.7.4: Primary winding shall be made out of high conducting Copper the current density for Short Circuit current as well conductivity for primary winding shall meet the requirement of IS:2705/1992 or its latest issue. However, for primary winding, Current density corresponding to the rated Short Time Current shall not exceed 160 Amps./Sq.mm. Suitably insulated Copper wire of electrolytic grade shall be used for secondary winding. The manufacturer/bidder should furnish details of primary winding e.g. Number of primary turns, cross-section, Short Time Current density and normal continuous rated current density in the primary winding so as to meet the requirement of relevant ISS. Windings shall have high mechanical strength for safety against short circuit stresses.

3.7.5: The shape of external metal parts shall ensure that rain water runs off and there is no stagnation.

3.7.6: The CTs shall be of robust design, tested quality and reliable in operation. Only pure high grade paper wound evenly under controlled conditions and impregnated with mineral oil under vacuum shall be used for the main insulation.

3.8 GALVANISING AND PAINTING:

All ferrous parts of 36 KV Instrument Transformers exposed to atmosphere including tank and secondary terminal box shall be painted externally with one coat of primer and two coats of synthetic enamel paint of light grey shade No. 631 of IS:5. All the interior surfaces in contact with oil shall be painted with two coats of suitable heat resistant oil insoluble paint. Minimum thickness of sheet should be 3mm. Welded joint have to be minimized to avoid the possibility of oil leakage. In any case welding in horizontal plane shall be avoided.
3.9 FITTINGS AND ACCESSORIES:

The CTs shall be provided with the following fittings and accessories:

(i) 2Nos. bimetallic terminal connectors with each CT suitable for horizontal and vertical takeoff. The thickness of bimetallic strip/sleeve shall be of min 2mm.
(ii) Oil level indicator/sight glass with marking of maximum, normal and minimum level.
(iii) Pressure release device if design recommended.
(iv) Expansion chamber or suitable type of device for absorbing variation in volume of oil due to change in temp. of oil.
(v) Oil filling/drain valve/plug/hole with sealing arrangement.
(vi) Lifting lugs/holes.
(vii) Weather proof secondary terminal box fitted with hinged/bolted door and complete with terminals and short circuit arrangement. The Secondary box & hinged/bolted door shall have sealing arrangement.
(viii) Two Nos. earthing terminals.
(ix) Name and rating plate, showing details of connection diagram.

4.0 36 KV POTENTIAL TRANSFORMER (PT):

The 36 KV Potential Transformers (PTs) shall be oil immersed, self cooled, outdoor type, hermetically sealed and shall be suitable for measuring/protection services. The Potential Transformer shall be suitable for outdoor installation with the protection from rain, dust & direct ray of Sun under the climatic conditions as specified in the specification and shall conform to the Standards mentioned in Clause No. 2.0 of the Specification. The 36 KV PT shall be Single Phase type.

The cores used shall be high grade non ageing laminated silicon steel having low hysteresis losses and high permeability. The reluctance of cores shall be as small as possible so as to reduce the ratio error and phase angle error in the PT. The Potential Transformer shall be hermetically sealed to eliminate breathing & prevent air and moisture from entering the tank and method adopted for hermetically sealing shall be stated clearly. The PTs shall be provided with oil level indicator/sight glass with marking of maximum, normal and minimum levels and pressure releasing device capable & releasing abnormal internal pressure. The primary & secondary windings shall be made out of Copper. The offered PTs shall be suitable for working under existing environmental conditions.

4.1 CORE WISE DETAILS OF 33 KV POTENTIAL TRANSFORMER:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated Primary Voltage</td>
<td>33/root 3 KV</td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>Single Phase</td>
</tr>
<tr>
<td>3</td>
<td>No. of Secondary</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Rated Voltage Factor</td>
<td>1.2 Continuous and 1.5 for 30 seconds.</td>
</tr>
<tr>
<td>5</td>
<td>Phase angle error</td>
<td>As per IS-3156 &amp; latest amendments.</td>
</tr>
<tr>
<td>6</td>
<td>Rated Voltage (Volts)</td>
<td>Sec-I Sec-II</td>
</tr>
<tr>
<td>7</td>
<td>Application</td>
<td>Protection Metering</td>
</tr>
<tr>
<td>8</td>
<td>Accuracy</td>
<td>3P 0.2</td>
</tr>
<tr>
<td>9</td>
<td>Rated output burden</td>
<td>50 VA 100VA</td>
</tr>
<tr>
<td>10</td>
<td>Value of Tan Delta at Um/root3</td>
<td>0.005 (Max.)</td>
</tr>
</tbody>
</table>

NOTE: The Accuracy of 3P & 0.2 should be maintained upto & including total Burden of 150 VA on both the windings.

4.2 INSULATION:
The Potential Transformer shall be capable to withstand satisfactorily the electric test voltage corresponding to basic insulation level of 170 KV Peak for 36 KV PTs.

4.3 TERMINAL BOX:

All secondary terminals shall be brought out in two secondary terminal boxes for each Potential Transformer, one for core 1 and other for core 2 as described in core-wise details of Potential Transformers. The secondary terminal box for core 2 should have arrangements for sealing. Necessary glands for receiving control cable suitable for mounting on the removable gland plate of the terminal box shall be included in the scope of the supply.

4.4 TEMPERATURE RISE:

The Potential Transformer shall be designed to limit the Temp. rise of windings and of other parts as specified in the standard when corrected for the difference between Temp. prevailing at site and Temp. specified by the standards. The Temp. rise when tested at 1.2 times rated voltage, frequency and rated burden and also when tested at 1.5 times rated primary voltage applied for 30 Sec. starting from previous stable operating conditions at rated frequency & rated burden shall not exceed the Temp. limits as specified in relevant IS.

5.0 INSULATING OIL AND BUSHING FOR CTs/PTs:

The quantity of insulating oil for first filling in each Instrument transformer and complete specification of the oil shall be stated. The oil shall be EHV Grade transformer oil and conform to the requirements of latest issue of IS: 335. The Instrument Transformers shall be supplied duly filled in with EHV insulating oil and shall be hermetically sealed. The bushing shall be of standard make such as W.S.I/BHEL/MIL/BIRLA NGK/CJI only and shall conform to the relevant latest IS:5621 & IS-2099. Any other make of bushing quoted should be supported by relevant type test reports as per IS-5621 and following test as per IS-2099:

(i) LIV test
(ii) HVPF (wet) test

The test should be got conducted from a Govt./Govt. approved/Govt. recognized/NABL accredited lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab) & such type test certificates should not be older than 7 years as on the date of Technical bid opening. For this purpose, the date of conducting type test will be considered.

6.0 TERMINAL CONNECTORS FOR CTs & PTs:

The Instrument transformers shall be supplied with bimetallic Terminal Connectors for both end suitable for ACSR Single Panther & Twin Tarantula conductors as per requirement below and confirming to IS-5561.

(A) 36 KV CURRENT TRANSFORMERS:

(i) Ratio 2400/1A, 4C - Twin Tarantula (with conductor spacing: 300 mm).
(ii) Ratio 500-1000/1A, 2C - Single Tarantula

(B) 36KV POTENTIAL TRANSFORMERS: ACSR Single Panther

Each Terminal Connector of Tarantula and Zebra/Panther conductors shall be suitable for both horizontal & vertical takeoff arrangements. The Terminal Connectors should be suitable for withstanding the 200% of continuous max. primary current for 15 minutes. The instrument transformer shall also be provided with two Nos. earthing terminals of adequate size protective against corrosion and metallically clean. Bimetallic strips or Sleeves of suitable thickness (Min.
2mm) to prevent bimetallic corrosion shall be provided as an integral part of Terminal Connector. The manufacturer/tenderer will furnish valid type test reports for ‘Short Time Current’ and ‘Temperature rise’ tests for Terminal Connectors of the type and make offered or get the test conducted from a Govt./Govt. approved/Govt. recognized/ NABL accredited test lab/ ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab). However, same will not be insisted if, the Terminal Connectors of make MILIND/NOOTAN/MEGHA/VINAYAK TRANSMISSION are supplied with CTs/PTs. The type test certificates should not be older than 7 years as on the date of Tech. Bid opening. For this purpose, the date of conducting of type test will be considered.

7.0 NAME/RATING PLATE:

The equipment included in this specification shall be provided with rating plates as per relevant standards. Rating plate and terminal marking shall be as per relevant IS. Purchase order/TN reference shall also be given on it.

8.0 TESTS:

(A) CURRENT TRANSFORMERS:

Each equipment covered under this specification shall comply with and shall be subjected to all routine/acceptance tests prescribed in the relevant Indian Standard/Specification as mentioned in Clause 2.0 above.

(i) The certified copies of tests reports from a Govt./ Govt. approved/Govt. recognized/NABL accredited lab/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign lab) of all type tests as per relevant latest standard mentioned in clause 2.0 in respect of similar rating and design of equipments included in this specification and Terminal Connectors (if offered other than approved makes) shall be furnished. The manufacturer/bidder shall furnish necessary calculations on the basis of STC test report furnished above to prove the CTs of offered ratios are capable to withstand the specified short circuit level. The type test reports shall not be older than 7 years from the date of technical bid opening. The type tests are detailed as hereunder:

(a) Short time current test:

   (i) On CTs of accuracy class 0.2s.
   (ii) On CTs of accuracy class 0.5 or better, if CTs are of 0.5 class.

(b) Lightning impulse voltage withstand test.

(c) Temperature rise test.

(d) High voltage power frequency (wet) withstand test.

Note: If the porcelain weather casing/bushing has been subjected to this test separately, the requirement of HVPF (Wet) test shall be deemed to have been complied.

(ii) Temperature rise test and instrument security current test shall be carried out once on one CT of each ratio in presence of the purchaser’s representative. The ISC test shall be carried out on all transformation ratios. However, one CT of each ratio alongwith Terminal Connector from each lot shall be tested at 200% of the rated max. primary current for 15 minutes.

(iii) Routine/acceptance tests as per relevant standard shall be carried out on equipment in presence of the purchaser’s representative. In addition to the routine/acceptance tests, all PS class CTs shall be tested in presence of Inspecting Officer to prove guaranteed values of minimum knee point voltage, turn ratio, secondary winding resistance etc.

Routine/acceptance tests to be conducted are as detailed under:
(a) Verification of terminal marking and polarity.
(b) Power frequency dry withstand test on primary winding.
(c) Power frequency dry withstand test on secondary winding.
(d) Over voltage inter turn test.
(e) Determination of error or other characteristics according to the requirement of the appropriate design of accuracy.

(iv) SAMPLING: The routine/acceptance test shall be conducted on 30% quantity offered for inspection.

(B) POTENTIAL TRANSFORMERS:

(i) The certified copies of tests reports from a Govt./Govt. approved/Govt. recognized/NABL accredited lab/ILAC i.e. International Laboratory Accreditation Cooperation(in case of foreign lab) of all type tests as per relevant latest standard mentioned in clause 2.0 in respect of similar rating and design of equipments included in this specification and terminal connector (if offered other than approved make) shall be furnished. The type test reports shall not be older than 7 years from the date of technical bid opening. The type tests are detailed as hereunder:

(a) Temperature rise test.
(b) Lightening impulse voltage withstand test.
(c) High voltage power frequency (wet) withstand test.
(d) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class (0.2 class).

Note: If the porcelain weather casing/bushing has been subjected to this test separately, the requirement of HVPF (Wet) test shall be deemed to have been complied.

(ii) Temperature rise test shall be carried out once on one PT in the presence of the purchaser’s representative.

(iii) Routine/acceptance tests as per relevant standard shall be carried out on equipment. Routine/acceptance tests to be conducted are as detailed under:

(a) Verification of terminal marking and polarity.
(b) Power frequency dry withstand test on primary winding.
(c) Power frequency dry withstand test on secondary winding.
(d) Over voltage inter turn test.
(e) Determination of error or other characteristics according to the requirement of the appropriate design of accuracy.

(iv) SAMPLING: The routine/acceptance test shall be conducted on 30% quantity offered for inspection.

9.0 MATERIAL AND WORKMANSHIP:

All the material used in the manufacturing of aforesaid equipments (CTs & PTs) shall be of best quality and capable of satisfactory operation under climatic conditions mentioned in specification. The workmanship shall be of the highest grade and the entire manufacturing shall be in accordance with the best modern engineering practice.

10.0 GUARANTEE PERIOD:

The guarantee period of each 33kV CT & PT shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 245 KV CAPACITOR VOLTAGE TRANSFORMER (CVT)

1.0 SCOPE:

This specification covers the design, manufacture, assembly and testing at manufacturer's works (before dispatch) of single phase, 50Hz oil immersed, self cooled outdoor type 245 KV capacitor voltage transformers (CVTs). These equipments shall be suitable for installation in system with neutral effectively grounded. The equipment should be complete in all respect and to the entire satisfaction of the purchaser. It will however be the responsibility of the supplier to supply all apparatus, appliances and material whether specifically mentioned or not but which may be found necessary to complete the equipment as well as for the perfect operation of the equipment.

2.0 STANDARDS:

The design, manufacture and testing of equipment covered by this specification shall comply with the latest issue of the following standards except the value(s) wherever specified shall be considered relevant.

   a) IS:9348- Specification for coupling capacitor and capacitor divider.
   b) IS:5547- Application guide for capacitor voltage transformers.
   c) IS:3156- Specification for voltage transformers (Part.I to IV).
   d) IS:5621- Specification for Hollow porcelain Bushing.
   e) IS:2099- Specification for Bushing.
   f) IS:5561- Specification for electric power connectors.
   g) IS:335- Specification for new insulating oil.
   h) IS:3070- Specification for lightning arrestors for A.C. System.
   i) IS:4146- Application guide for voltage transformers.
   j) IS:3347- Dimension of Porcelain transformer bushings.
   k) IS:2071- Method of high voltage testing.
   l) IS:2165- Insulation Co-ordination for equipment for 100KV & above.
   m) IS-2633- specification for ferrous metal galvanization.
   n) IEC 867

Equipment and material confirming to other internationally recognized standards which ensure quality equal to or better than the Indian Standard mentioned above, would also be acceptable. In case the tenderers wish to offer equipment confirming to other standards they shall furnish an English translation of the relevant standard.

3.0 PRINCIPAL TECHNICAL PARAMETERS:

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>PARTICULARS</th>
<th>245 KV CVTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NOMINAL SYSTEM VOLTAGE</td>
<td>220 KV</td>
</tr>
<tr>
<td>2</td>
<td>HIGHEST SYSTEM VOLTATAGE.</td>
<td>245 KV</td>
</tr>
<tr>
<td>3</td>
<td>RATED SYSTEM FREQUENCY/PHELSE</td>
<td>50 Hz / 3 PHASE</td>
</tr>
<tr>
<td>4</td>
<td>TYPE OF EARTHING</td>
<td>EFFECTIVELY EARTHED</td>
</tr>
<tr>
<td>5</td>
<td>TYPE OF MOUNTING</td>
<td>PEDESTAL TYPE</td>
</tr>
<tr>
<td>6</td>
<td>NO. OF PHASES FOR CVTs</td>
<td>SINGLE PHASE</td>
</tr>
<tr>
<td>7</td>
<td>NO. OF SECONDARY WINDING OF POTENTIAL DEVICE.</td>
<td>THREE</td>
</tr>
<tr>
<td>8</td>
<td>RATED SECONDARY VOLTAGE :</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) WINDING - I</td>
<td>110/ √3V</td>
</tr>
<tr>
<td></td>
<td>II) WINDING -II</td>
<td>110/ √3V</td>
</tr>
<tr>
<td></td>
<td>III) WINDING -III</td>
<td>110/ √3V</td>
</tr>
</tbody>
</table>
9 RATED OUTPUT OF EACH SECONDARY WINDING:
   i) WINDING - I  25 VA
   II) WINDING - II 25 VA
   III) WINDING - III 25 VA

10 CLASS OF ACCURACY & PURPOSE OF EACH SECONDARY WINDING:
   i) WINDING - I 3P FOR PROTECTION.
   ii) WINDING - II 3P FOR PROTECTION
   iii) WINDING - III FOR METERING 0.2

11 TRANSFORMATION RATIO:
   i) WINDING - I,II & III 220KV / 110 V

12 MAX. TEMPERATURE RISE. (WITHIN LIMITS AS LIMITES OF TEMP.RISE OF WINDING.) (LATEST AMENDMENT ISSUED THEREOF)

13 MAX. RATIO (VOLTAGE) ERRORS. -DO-

14 MAX. PHASE DISPLACEMENT ERRORS. -DO-

15 VOLTAGE FACTOR 1.2 CONTINUOUS & 1.5 FOR 30 SECONDS.

16 RATED INSULATION LEVEL:
   A) 1.2/50 µ.s. IMPULSE WITHSTAND VOLTAGE. 1050 KV (PEAK)
   B) ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE. 460 KV (RMS)

17 RATED CAPACITANCE. 4400 pF WITH TOLERANCE +10% AND -5%

18 VALUE OF STRAY CAPACITANCE AND STRAY CONDUCTANCE IN THE CARRIER FREQUENCY RANGE OF 40 TO 500 KHZ FOR COMPLETE CVT BETWEEN LOW VOLTAGE TERMINAL AND EARTH TERMINAL (FOR CVT WITH EMU)
   a) STRAY CAPACITANCE. SHALL NOT EXCEED 520 pf.
   b) STRAY CONDUCTANCE. SHALL NOT EXCEED 50 µs

19 a) HIGH FREQ. CAPACITANCE FOR ENTIRE CARRIER FREQ. RANGE. WITHIN 80% TO 150% OF RATED CAPACITANCE.
   b) EQUIVALENT SERIES RESISTANCE OVER THE ENTIRE CARRIER FREQ. RANGE. LESS THAN 40 Ohms

20 TEMPERATURE CATEGORY ABOVE- 10 DEG.C.TO +50 DEG.C.

21 ONE MINTUTE POWER FREQUENCY TEST
   a) WITHSTAND VOLTAGE BETWEEN LOW 10 KV IF EXPOSED TO
| **VOLTAGE TERMINAL & EARTH TERMINAL (IN RMS)** | **ATMOSPHERE AND 4 KV IF NOT EXPOSED.** |
| **WITHSTAND VOLTAGE FOR SECONDARY WINDING.** | **3 KV (RMS)** |
| **TANGENT OF LOSS ANGLE AT RATED FREQUENCY AND RATED VOLTAGE.** | **NOT MORE THAN 2X10⁻³** |
| **MIN. CREEPAGE DISTANCE OF PORCELAIN HOUSING (MM)** | **6125** |
| **VISUAL CORONA EXTINCTION VOLTAGE (KV RMS)** | **176** |
| **REFERENCE RANGE OF FREQ. FOR WHICH REQUIRED ACCURACIES ARE VALID** | **97% TO 103% OF RATED FREQ.** |
| **FOR PROTECTION APPLICATION** | **99% TO 101% OF RATED FREQ.** |
| **FOR METERING APPLICATION** | **50 VA** |

### 4.0 GENERAL DESCRIPTION FOR 245 KV CAPACITOR VOLTAGE TRANSFORMER:

#### 4.1: The capacitor voltage transformer shall be suitable for line to ground connection. It shall be formed by two independent main parts, a capacitor potential divider column and an electromagnetic unit, assembled together to constitute a complete CVT unit.

#### 4.2: The capacitor potential divider shall consists of series connected capacitors fully immersed in insulating oil having high dielectric constant and high chemical stability contained in a hermetically sealed porcelain housing. An intermediate tapping shall be provided for supply to the electromagnetic unit. The capacitor shall serve as capacitor potential divider as well as coupling capacitor.

#### 4.3: The electromagnetic unit shall be contained in a separate oil filled welded steel tank, which also form the mounting of the capacitor column. The earthing link/connection shall exist between upper portion and bottom portion of the tank which is separated by an ‘O’ ring or gasket. The electromagnetic unit shall comprise of intermediate potential transformer (whose primary is fed from the intermediate tapping from the capacitor potential divider), a compensating reactor, a damping device, a surge voltage arrester, etc. The secondary terminals of the electromagnetic unit shall be brought out in a weather proof box outside the steel tank housing of the electromagnetic unit. Screwed connection should not be accepted. Internal connection should have lock nut or locking feature to prevent loosening of studs. The terminal box shall be hot dip galvanized. The terminal box shall have 2 Nos. cable glands of 25 mm size for receiving Control cables and hinged door provided with locking arrangement. The door shall have suitable arrangement to check the ingress of moisture into the terminal box. HRC fuses of 16 Amp rating shall be provided in each secondary terminal box. The rating, type and make of fuses provided shall be indicated in the drawings. Necessary oil level indicator, filling and sampling valves/suitable arrangement shall be provided on the tank. Connection diagram, rating plate and two grounding terminals of size 75x50 mm protected against corrosion and metallically clean, shall also be provided on the tank.

#### 4.4: (a) PORCELAIN HOUSING: The details of location & type of joint, if provided, on the porcelain, shall be furnished by the supplier. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength, glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or...
condensed water particles (fog). The profile of porcelain shall be aerodynamic type as per IEC-815.

(b) Details of attachment of metallic flanges to the porcelain shall be furnished.

(c) The metal tank shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. The metal tank shall be made out of steel/stainless steel/aluminium alloy, depending on the requirement. Welding in Horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage.

4.5: The grounding connection of the potential divider shall preferably be let out of the steel case through a suitable bushing. When the CVT is not to be used for carrier coupling, the grounding connection shall be earthed through a suitable grounding switch or link. The details of grounding switch must be clearly shown in the drawing.

4.6: All ferrous parts of CVT including tank & secondary terminal box shall be hot dip galvanized as per IS:2633 (latest amendments), Bolts, nuts, screws, pins, washers etc, used in the equipment shall also be galvanized either hot dip or electrically. All current carrying parts shall be of nonferrous metals or alloy and shall be designed to limit sharp point edges etc.

5.0 DESIGN REQUIREMENT:

5.1: The CVT shall confirm to the standards and technical particulars as mentioned above and shall be suitable to use as measuring unit as well as a coupling capacitor for the power line carrier communication network i.e. voice communication, carrier protective relaying, tele-metering and teleprinting service over one or more carrier channels in 40 KHz to 500 Khz frequency range. The CVT shall be provided with an insulated low voltage terminal for connection to H.F. coupling unit, the CVTs shall have an inductive reactance (HF Choke) connected preferably between intermediate voltage terminal & primary of EMU to minimize attenuation to the carrier frequencies. The details of HF chock be clearly mentioned in the drawing for CVT.

5.2: Each capacitor voltage transformer shall be suitable for connection directly to the bus/line without the use of auxiliaries such as isolating switch or fuse. The capacitor of the unit shall be so designed that application of lightning impulse voltage of the magnitude as per relevant standard shall not damage the internal working of elements or cause a change in their electrostatic capacitance.

5.3: The intermediate potential transformer shall be of oil immersed self cooled designed and shall be suitable for metering, relaying and synchronizing services, The core of this transformer shall be made of non ageing, cold rolled, laminated, electrical grade silicon steel having low hysteresis loss and high permeability so as to ensure high accuracy, at normal as well as at over voltage. The primary winding shall be connected through a reactor suitable for compensating any increase in the intermediate tapping point voltage at all loading upon the rated burden.

5.4: (a) The CVT shall be provided with a suitable device so that ferro-resonance and other oscillations due to saturation of iron core of transformer or due to any inductance connected in parallel with it as initiated by either over voltages on the network side or by opening of the short circuited primary or secondaries, are practically zero for no burden to rated burden. Oscillations of the secondary voltages which may rise as a result of breakdown of primary voltage due to short circuits shall not affect the proper working of protective relays. The design of the compensating reactor and the intermediate potential transformer as well as of the damping device, inserted in the winding of the intermediate transformer shall be such that ferro-resonance should not occur.
(b) The Capacitor voltage divider shall be capable of being used over complete carrier frequency band width. The value of capacitance shall be suitably chosen for reliable wide band carrier operation.

5.5 WINDING:

5.5.1: The primary of the potential device shall be connected to a suitable tap of the capacitor potential divider. The secondary of the intermediate potential transformer shall be provided with three separate windings, each rated for 110/√3 volts.

5.5.2: The rated output burden of the secondary windings and the accuracy class at 25% to 100% VA burden for protection cores and metering core shall be as per the table below.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Burden/Accuracy class</th>
<th>Core 1</th>
<th>Core 2</th>
<th>Core 3</th>
<th>Simultaneous Burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Burden (VA)</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>(b)</td>
<td>Accuracy Class</td>
<td>3P</td>
<td>3P</td>
<td>0.2</td>
<td>--</td>
</tr>
</tbody>
</table>

5.6 TEMPERATURE RISE:

The CVT shall be designed to limit the temp. of winding and other parts as specified in the standards, when corrected for the difference between temperature prevailing at site and temperature specified by the standards. The temperature rise at 1.2 times rated primary voltage and at rated frequency and rated burden shall not exceed the limits specified above and the temperature rise at 1.5 times rated primary voltage when applied for 30 seconds shall not exceed the limits as mentioned in the relevant standards.

6.0 INSULATION:

The CVT shall withstand satisfactorily electric test voltages corresponding to the values mentioned in the relevant Indian Standard.

7.0 INSULATING OIL:

The quantity of insulating oil for first filling in each equipment shall be stated. The insulating oil shall confirm to the requirements of latest issue of IS:335 along with its all amendments. The CVT shall be supplied duly filled with insulatingoil and shall be hermetically sealed. The CVT manufacturer as an option may use synthetic insulating liquids, confirming to IEC-867 or equivalent with latest revision, in capacitor column.

8.0 TERMINAL CONNECTORS:

All the CVTs required shall be provided with one number each of suitable size solder less, clamp type aluminium alloy Terminal Connector suitable for Single ACSR ZEBRA or Single AL-59 (Moose) conductors. Each terminal connector shall be suitable for both horizontal and vertical connections. The terminal connector should have spring washer & double nut provision in each bolt. The Nuts & bolts shall be hot dip galvanized. The CVTs shall also be provided with two Nos. earthing terminals of size 75x50 mm protected against corrosion and metallically clean.

9.0 BUSHING/ INSULATORS:

The bushing/insulators shall be of standard make such as W.S.I/BHEL/MIL/IEC/Birla NGK.

10.0 TYPE OF MOUNTING:
The CVTs shall be suitable for mounting on both steel structures and concrete pedestals.

11.0 DRAWINGS/MANUALS:

11.1 DRAWINGS:

The following dimensional drawings in addition to the other special characteristic drawings/literature shall be submitted:

(i) Outline dimensional drawings showing general arrangement & loading data of equipment.
(ii) Drawings showing inside details (vertical sectional view of equipment).
(iii) Drawings showing details of Terminal Connectors with number of bolts and washers.
(iv) Drawings showing details of mounting arrangement.
(v) Drawings of connection diagrams showing the details of secondary terminals.
(vi) Technical and descriptive literature explaining constructional features and the details of the equipment.
(vii) Name/rating plate.
(viii) Drawings depicting magnetization curve for each of the secondaries.
(ix) Accuracy curves for CVTs will be supplied with each CVT of frequency ranges.
(x) Drawing for hollow porcelain insulators indicating all details.

12.0 INSPECTION & TESTING:

12.1 TYPE TEST

245 KV CVT shall comply with the requirement of type tests as per relevant standards. The type test certificates issued from a Govt/Govt. approved/Govt. recognized/NABL accredited laboratory/ILAC i.e. International Laboratory Accreditation Cooperation (in case of foreign laboratory) of similar rating and design shall be furnished. Such Type test certificates should not be older than 7 years as on the date of Technical bid opening. For this purpose date of conducting type test will be considered. Type test reports from in house laboratory of tendering firm, even if it is a Govt/Govt. approved/Govt. recognized/NABL accredited laboratory/ILAC accredited will not be accepted in case of their own tender. However, this will not apply, if tendering firm is a Govt. Company/Undertaking.

12.2 ROUTINE TEST

The CVTs shall be subjected before dispatch to stipulated routine test at manufacturers work’s during the process of manufacture visiting inspector or any other representative of purchaser may examine this record.

12.3 INSPECTION

No equipment shall be dispatch from its point of manufacturer unless the material has been satisfactorily inspected and cleared by RSDCL.

The inspection of the equipment shall be carried out by the purchaser in accordance to the relevant standards on 100% of the offered quantity.

Inspection and acceptance of any quantity of equipment shall in no way relieve the supplier from his responsibility for meeting all the requirements of this specification and this shall not prevent subsequent rejection, if such equipment is later found defective.

13.0 NAME/RATING PLATE:

All items of the equipment included in this specification shall be provided with name/rating plates as per relevant standards. Rating plate and terminal marking shall be as per relevant ISS. The TN No. and P.O. No. must be provided on the name plate.
14.0 MATERIAL AND WORKMANSHIP:

All materials used in the manufacture of aforesaid equipment shall be of best quality and capable of satisfactory operation under climatic conditions specified in the specification. The workmanship shall be of the highest grade & the entire manufacture shall be in accordance with the best modern engineering practice.

15.0 COMPLETENESS OF EQUIPMENT:

All fittings accessories or apparatus which may have not been specifically mentioned in this specification but which are usual or necessary for the completeness of the equipment, shall be deemed to have been included in this specification.

16.0 GUARANTEE PERIOD:

The guarantee period of each CVT shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 245 KV, 2000 AMP, DOUBLE BREAK, BANGING TYPE, MOTOR OPERATED ISOLATORS

1.0 SCOPE:

This specification covers design, engineering, manufacture, assembly, inspection and testing, packing and delivery with all fittings, accessories and auxiliary equipments of 245 kV, 2000 Amp Isolators with single earth switch, with double earth switch and without earth switch (Air break Disconnectors) to be installed at 220 kV Park Pooling Sub-stations under this turnkey project. The related civil works, if any, for fixing of motor & its mechanism box in the isolator shall be in the scope of the contractor.

It is not the intent to specify completely herein all details of the design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing continuous service. The purchaser will interpret in a manner the meaning of drawings and specification and shall have the power to reject any work or material which in his judgement is not in accordance herewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation alongwith associated equipments, interlocks, protection schemes etc. Such components shall be deemed to be within the scope of supply, irrespective of whether these are specially brought out in this specification or not. All similar parts particularly movable ones shall be interchangeable.

1.1 STANDARDS:

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the isolators/ isolators with earth switch their accessories and fittings shall conform to the latest revisions and amendments of the following standards:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Standard No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS:9921</td>
<td>Alternating Current Isolators (Disconnectors) and Earthing Switches.</td>
</tr>
<tr>
<td>2.</td>
<td>IEC:129</td>
<td>do-</td>
</tr>
<tr>
<td>3.</td>
<td>IS:13947</td>
<td>Degree of Protection Provided by Enclosure.</td>
</tr>
<tr>
<td>4.</td>
<td>IS:4691</td>
<td>do-</td>
</tr>
<tr>
<td>5.</td>
<td>IS:2629</td>
<td>Recommended Practice for Hot Dip Galvanising of Iron and Steel.</td>
</tr>
<tr>
<td>6.</td>
<td>IS:4759</td>
<td>Hot Dip Galvanisation Coating on Structural Steel.</td>
</tr>
<tr>
<td>7.</td>
<td>IS:2633</td>
<td>Method of Testing Uniformity of Coating on Zinc Coated Articles.</td>
</tr>
<tr>
<td>8.</td>
<td>IS:1573</td>
<td>Electroplated Coatings of Zinc on Iron and Steel.</td>
</tr>
<tr>
<td>9.</td>
<td>IS:6735</td>
<td>Spring Washers.</td>
</tr>
<tr>
<td>10.</td>
<td>IS:2016</td>
<td>Plain Washers.</td>
</tr>
<tr>
<td>11.</td>
<td>IS:5561</td>
<td>Electrical Power Connectors. (Terminal Connectors)</td>
</tr>
<tr>
<td>12.</td>
<td>--</td>
<td>Indian Electricity Rules</td>
</tr>
<tr>
<td>13.</td>
<td>IS:9530</td>
<td>Recommended Practice for Silver Plating.</td>
</tr>
<tr>
<td>14.</td>
<td>BS:2816</td>
<td>Testing of Silver Plating Thickness.</td>
</tr>
<tr>
<td>15.</td>
<td>IS:5925</td>
<td>Recommended Practice for Silver Plating for General Engineering Purposes.</td>
</tr>
<tr>
<td>16.</td>
<td>IS:325</td>
<td>Three phase Induction motors</td>
</tr>
<tr>
<td>17.</td>
<td>IS:4722</td>
<td>Rotating Electrical Machines.</td>
</tr>
</tbody>
</table>

2.0 AUXILIARY POWER SUPPLY:

The offered 245 kV Isolators under this specification shall be suitable for the following auxiliary power supplies:

(a) Power Device (like drive motors) : 415V, 3 Phase, 4 Wire, 50 Hz, neutral grounded AC.
(b) AC control and protective devices, lighting fixtures, space heaters and FHP motors. : 240 V, 1 Phase 2 Wire 50 Hz, neutral grounded AC.
3.0 PRINCIPAL PARAMETERS:

The equipment covered in this specification shall meet the technical requirements listed below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>TECHNICAL PARAMETER</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rated Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>2.</td>
<td>System Neutral Earthing</td>
<td>Effectively Earthed</td>
</tr>
<tr>
<td>3.</td>
<td>No. of Phases (Poles )</td>
<td>3 Phases</td>
</tr>
<tr>
<td>4.</td>
<td>Temperature Rise</td>
<td>As per relevant IS/ IEC publication/ Specification</td>
</tr>
<tr>
<td>5.</td>
<td>Safe Duration of overload:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) 150% of rated current</td>
<td>5 Minutes</td>
</tr>
<tr>
<td></td>
<td>b) 120% of rated current</td>
<td>30 Minutes</td>
</tr>
<tr>
<td>6.</td>
<td>Class</td>
<td>Outdoor</td>
</tr>
<tr>
<td>7.</td>
<td>Type of Isolator</td>
<td>Double Break, centre post rotating banging type</td>
</tr>
<tr>
<td>8.</td>
<td>Rated voltage</td>
<td>245 KV rms</td>
</tr>
<tr>
<td>9.</td>
<td>Rated normal current</td>
<td>2000 Amp rms</td>
</tr>
<tr>
<td>10.</td>
<td>Rated short time withstand current of Main Switch &amp; earth switch for 1 second duration</td>
<td>40 KA rms</td>
</tr>
<tr>
<td>11.</td>
<td>Rated peak withstand Current</td>
<td>100 KA peak</td>
</tr>
<tr>
<td>12.</td>
<td>Rated short circuit making current of Earth Switch</td>
<td>100 KA peak</td>
</tr>
<tr>
<td>13.</td>
<td>Basic insulation level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i) 1.2/50 micro second lightning impulse withstand voltage (+ve or –ve polarity)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) To earth and between poles</td>
<td>1050 KVP</td>
</tr>
<tr>
<td></td>
<td>(b) Across isolating distance (one terminal subjected to lightning impulse and opposite terminal earthed)</td>
<td>1200 KVP</td>
</tr>
<tr>
<td></td>
<td>(ii) Rated 1 minute power frequency withstand voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Across isolating distance</td>
<td>530 KV rms</td>
</tr>
<tr>
<td></td>
<td>(b) To earth and between Poles</td>
<td>460 KV rms</td>
</tr>
<tr>
<td>14.</td>
<td>Min. creepage distance of support and rotating Insulators</td>
<td>6125 mm</td>
</tr>
<tr>
<td>15.</td>
<td>Phase to Phase spacing for installation (center to center)</td>
<td>4500 mm</td>
</tr>
<tr>
<td>16.</td>
<td>Minimum clearances</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Phase to earth</td>
<td>2300 mm</td>
</tr>
<tr>
<td></td>
<td>(b) Isolating distance between poles of same phase (center to center)</td>
<td>2700 mm</td>
</tr>
<tr>
<td>17.</td>
<td>Rating of auxiliary contacts</td>
<td>10 A at 220 V DC/110 V DC With breaking capacity of 2 Amp. DC with time constant not less than 20 ms</td>
</tr>
<tr>
<td>18.</td>
<td>Climatic conditions</td>
<td>As specified</td>
</tr>
<tr>
<td>19.</td>
<td>Rated mechanical terminal load</td>
<td>As per relevant standards</td>
</tr>
</tbody>
</table>
20. Operating time 12 sec or less
21. Rated magnetising/ capacitive current make/ break 0.7 Amps rms
22. RIV at 1 Mhz & 1.1 x rated phase to earth voltage 1000 micro volts
23. Min. thickness of silver coating on contacts 40 microns

4.0 GENERAL TECHNICAL REQUIREMENTS:

4.1 DESCRIPTION OF THE EQUIPMENT:

4.1.1: The 245KV Isolators covered by this specification shall be Centre Post Rotating, Double Break, Banging type (horizontal break having double break per phase) without and with single vertical fork and lift type earthing blade per pole suitable for fixing on either side of the poles and Tandem type. The motorized isolators shall be gang operated and the blades shall rotate in the horizontal plane. The isolators shall be provided with proper studs for the perfect leveling of all the phases of the isolator. Suitable arrangement shall be provided on the support structures for fixing the operating mechanism for the earth blades. The isolators shall be so designed that addition of earth switch on one or both sides shall be possible in future.

4.1.2: Complete isolators with all the necessary items for successful operation shall be supplied including but not limited to the following:

4.1.2.1: Isolators assembled with isolator blades (main & earth), complete base frame, linkages, operating mechanism etc.

4.1.2.2: One central control cabinet for each isolator with all the required electrical devices mounted therein and necessary terminal blocks for termination shall be provided.

4.1.3: The isolators/ earth switch shall be complete with base channel boxes suitable for mounting post insulators. It shall be supplied with suitable clamps, bolts, nuts and washers for mounting.

4.1.4: The current transfer assembly shall be either solid type or of laminated copper strip.

4.1.5: The three phase motor operated isolator and earth switch shall be manufactured out of the best grade of material suitable for the weather conditions prevailing in the Rajasthan.

4.1.6: All ferrous parts shall be hot dip galvanised. All bearings in the current path except those specifically designed as high pressure contact shall be shunted by flexible copper connector of suitable cross section.

4.1.7: The insulator of isolators and earth switch shall be so arranged that leakage current will pass to earth and not between terminals of the same pole or between poles.

4.1.8: It shall not be possible after final adjustments have been made for any part of the mechanism to be displaced to any point of travel so as to allow improper functioning when the switch is operated.

4.2 DUTY REQUIREMENTS:

4.2.1: The isolator and earth switch shall be capable to withstand the rated mechanical terminal load and electromagnetic forces without impairing their operation reliability. The rated mechanical load shall be specified. The earth switch isolator shall be such that they cannot come out of their open or close position by gravity, wind pressure, vibrations or accidental touching of the operating...
rod. Suitable electrical and mechanical interlock shall be provided to prevent closing of earth switch when isolator is closed and also prevent closing of isolator when earth switch is closed. Isolators and earthing switch shall be capable of withstanding the dynamic and thermic effects of the maximum possible short circuit current of the systems in their closed position. The isolators shall be so designed that they do not open under the influence of short circuit current.

4.2.2: The isolator shall be capable of making/breaking normal currents when no voltage difference occurs across the terminals of each pole of isolator on account of make/ break operation.

4.2.3: The isolator shall be capable of making/ breaking magnetising current of 0.7 A at 0.15 power factor and capacitive current of 0.7 A at 0.15 power factor.

4.2.4: Isolator & earth switch shall be able to bear on the terminals the total forces including wind loading and electrodynamic forces on the attached conductor without impairing reliability or current carrying capacity.

4.3 BASE CHANNEL:

4.3.1: The compound structure of base channel boxes of isolator shall be fabricated from two numbers of MS channels of atleast 150mm x 75mm size for 245KV Isolators. The base channels of the frame should face inside towards each other. They should be welded (not bolted) using adequate bracing at a maximum 500 mm interval to make the frame rigid. The centre to centre distance between the channels shall be 320 mm minimum.

4.3.2: For 245 KV Isolators, total 8 elliptical holes of 18mm x 50mm shall be provided so that the frame of the Isolator can be mounted on the structure without any modification. For 245KV Isolator, the centres of 8 elliptical holes for fixing the frame on structure shall be at distance of 864 mm (4 holes) and 1264 mm (4 holes) from the centre line of the frame on both sides and both channel. Two independent 12 mm thick earthing plates of size 100mm x 100mm shall be provided on the base for bolting the earthing flat of 100mm x 12mm size. Two holes of 15 mm diameter shall be provided on these plates.

4.4 OPERATING MECHANISM:

4.4.1: The three phase 245 KV Isolators shall be remote controlled from the Control Room. Provision shall be made for local motor control also. Operating mechanism shall also be equipped with local manual operating device intended for emergency operation when motor operating mechanism becomes in-operative. The height of manual operating handle from ground level shall be 1300 mm. Additional electromagnetic type interlock shall be provided on the manual operating handle so as to prevent the operation of isolator manually or electrically when the corresponding circuit breaker is ON. Suitable interlock shall be provided such that during manual operation, electrical operation shall be automatically rendered inoperative by interrupting the power supply.

4.4.2: Manual operating mechanism through crank and reduction worm gear shall be provided for isolator earth switch. The height of manual operating handle from ground level shall be 1300 mm for 245 KV Isolator. The operating handle shall be provided with insulation layer for operator safety.

4.4.3: The operating mechanism shall provide quick, simple and effective operation. The design of manual operation shall be such that one man shall be able to operate the isolator without undue effort. The operating mechanism shall be suitable to hold the disconnector in CLOSE OR OPEN position and prevent operation by gravity, wind, short circuit forces, seismic forces, vibration, shock, accidental touching etc.,

4.4.4: Limit switches for control shall be fitted on the Isolator/ earth switch shaft within the cabinet to sense the Open and close positions of the isolators and earth switches. Limit switches shall also have three (3) spare contacts for Purchaser's use for indication and control circuits.
4.4.5: It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficient enough to cause improper functioning of the isolator when the isolator is opened or closed at any speed. All holes in cranks, linkage etc., having moving pins, shall be drilled to fit accurately so as to maintain the minimum amount of slack and lost-motion in the entire mechanism.

4.4.6: A local/remote selector switch and a set of Open and Close push buttons shall be provided on the control cabinet of the isolator to permit its operation through local or Remote push buttons. The remote push buttons shall be arranged by the purchaser.

4.4.7: Provision shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.

4.4.8: Each motor operated mechanism shall be subjected to Blocked rotor test.
4.4.9: A vertical down pipe operating shaft of suitable length (not less than 2.35 meter) to suit mounting height of structure and supported on ball or roller bearing in its shaft shall be provided.

4.4.10: Each rotating insulator stool of isolator shall have taper roller bearing at top & ball bearing at other end. The thickness of plate on the rotating stool shall be at least 12 mm. Eight (8) Nos. holes of 18 mm diameter at a PCD of 225 mm on this plate of the stool for fitting the post insulators shall be provided. The vertical distance between bearings should be minimum 150 mm centre to centre. The bearings shall be of at least 75 mm shaft diameter. The bearings shall be of reputed make eg. SKF, HMT, NBC, TATA. The levelling plate on which the bearing housing is mounted shall have a minimum thickness of 12 mm. The bolts provided for junction shall have a minimum diameter of 20 mm.

4.4.11: The entire mechanical load shall be suspended on taper roller bearing. The bearing shall be adjustable and accessible for dismantling in the field. The rotating insulator shall be mounted on a housing with bearing housing. The bearing housing shall be weather proof and facilities for lubrication of bearing shall be provided. The housing shall be made of gravity die cast aluminium with smooth surfaces suitably machined for seating the bearings. Two nos. of bearings with adequate shaft diameter and distance between the bearings shall be provided to avoid wobbling during operations.

4.4.12: All other friction locations shall be provided with bearings, bushes, joints, springs etc., and shall be so designed that no lubrication shall be required during service. Complete details of bearings, bushes, housing, greasing etc., shall be stated. The earthing shaft shall also be provided with necessary bearings.

4.4.13: The down operating pipe, phase coupling pipe & tandem pipe connecting poles of the same phase shall not be less than 50 mm, 32 mm and 25 mm nominal bore respectively. All G.I. pipes used in operating mechanism of isolators & earthing switch shall be of class B as per relevant IS. The operating pipe shall be terminated into a suitable swivel or universal type joint at both ends between the insulator bottom bearing and the operating mechanism to take care of marginal angular misalignment at site.

4.4.14: Each phase of isolator shall be provided with a rigid base fabricated from steel sections. The base shall be suitable for mounting on support structures. Fabrication, welding etc., shall be done by suitable jig, power press and templates to avoid deviations during production.

4.5 CONTROL CABINET:

4.5.1: The control cabinet of the operating mechanism shall be made out of 12 SWG hot dip galvanized sheet steel and shall be weather and dust proof. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP-55 as per IS:13947. Separate cabinet made out of 12 SWG hot dip galvanized sheet steel shall be provided
with each earthswitch operating mechanism. The cabinet for both main and earth switch shall be mounted on galvanized support structure with adjustment for horizontal and vertical alignment. The support structure with suitable hardware is also in the scope of supply. Details of these arrangements along with the size of the cabinet shall be furnished.

4.6 MOTOR:

The motor shall be suitable for 3 phase, 415 V AC supply with variations as specified in this specification. It shall be totally enclosed type if mounted outside the control Cabinet. The motor shall withstand without damage stalled torque for at least three times the duration of tripping device. The motor shall, in all other respects, conform to the requirement of IS-325. The make of motor shall be CROMPTON / ABB / SIEMENS only.

4.7 GEAR:

The isolator may be required to operate occasionally, with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet this requirement. The worm gears shall be made out of bronze or any other better material and lubricated for life with graphite or better quality non draining and non hardening type grease. Wherever necessary automatic relieving mechanism shall be provided. Complete details of components, material, grade, self lubricating arrangement, grade of lubricants, details of jig, fixtures and devices used for quality check, shall be furnished by the tenderer in his offer.

4.8 GLAND PLATE AND GLANDS:

A removable gland plate with double compression type brass cable glands shall be provided with each operating mechanism for terminating all cables. Two (2) Nos. of 32 mm and one (1) no. 25 mm for earth switch operating mechanism and three (3) Nos. of 32 mm and one (1) No. of 25 mm glands for main operating mechanism shall be provided.

4.9 CONTROL CIRCUITS:

Control device shall store OPEN and CLOSE command even if the corresponding switch is momentarily pressed until the command is fully executed and the components get deenergised after execution. Failure of auxiliary power supply or loose contact shall not cause faulty operation.

4.10 LIMIT SWITCH:

Limit switches shall be of reputed make. Auxiliary switch shall not be used as Limit switch. Details of make, rating and type of limit switch shall be furnished.

4.11 OVERLOAD AND SINGLE PHASING PREVENTOR:

Suitable relay/ device shall be provided to prevent overloading of the motor. Single phase preventer shall be provided to operate on open circuiting of any phase and shall trip off the motor and disconnect the control supply. The motor shall be protected by using separate single phasing preventor and overload relay. These shall also be used to cut-off the control supply of the operating mechanism. Complete details of the devices shall be furnished.

4.12 CONTACTOR:

The contactor shall be suitable for making and breaking stalled motor current. The contactor coil shall be suitable for 220 V D.C. or three phase 415 V A.C. with suitable inter-locking D.C. relay to cut off A.C. supply to the motor in accordance with the interlocking scheme. Two nos. of contactors shall be provided for each motor for OPEN and CLOSE operation respectively. One Contactor shall be provided for the electrical interlocking system. A timer shall be provided for
providing alarm and opening the control circuit in case the isolator does not perform the operation in the specified time. Make, type, rating and details of the contactor shall be furnished.

4.13 AUXILIARY SWITCH:

4.13.1: The isolators shall be provided with open drum type auxiliary switch with all contacts visible & replaceable to facilitate adjustment/inspection in the field. Each operating mechanism box shall be equipped with twelve Nos. of NO and twelve Nos. of NC auxiliary switches exclusively for Purchaser’s use. Eight pairs of NO and Eight pairs of NC contacts shall be provided in the auxiliary switch box for each operating mechanism for earth switch. The contacts of auxiliary switches shall be silver plated. The auxiliary switches shall be of reputed make and of best quality. Auxiliary switches other than open drum type shall not be accepted.

4.13.2: The auxiliary switches and auxiliary circuits shall be capable of carrying the current of atleast 10 Amps continuously with adequate breaking capacity.

4.13.3: Auxiliary switches shall be capable of breaking at least 2A in a 220 V DC circuit with a time constant of not less than 20 milliseconds.

4.13.4: The RMS withstand voltage shall be 2 KV for one minute. The auxiliary switches shall be positively driven in both directions by rigid members. The insulating material for the auxiliary switches shall be ceramic or other non-cracking material.

4.13.5: The auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the isolator operating pipe and shall be without any intermediate levels, linkages etc., to ensure foolproof operation.

4.13.6: The auxiliary switches which are installed on the frame of isolator shall be suitably protected from accidental arcing from the main circuit. A drawing of auxiliary switch included in the scope of supply shall be furnished. The auxiliary switch contacts shall be accessible when the isolator is live and signalling for open will not take place unless moving contacts have fully separated.

4.14 SPACE HEATER:

Space heater suitable for 1-phase, 240 V AC supply shall be provided for motor operated operating mechanism to prevent condensation. A switch and fuse/link shall be provided in the operating mechanism.

4.15 TERMINAL BLOCK AND WIRINGS:

Each operating mechanism shall be provided with 1100 V grade stud type terminal block. All auxiliary switches, interlocks and other terminals shall be wired upto terminal block. The terminal block shall have at least 20% extra terminals. All wiring shall be carried out with 1100 V grade insulated 2.5 sq. mm copper wires.

4.16 ARCING HORNS:

The arcing horns provided on the isolators shall be capable of breaking the magnetising current of the transformers up to the capacity of 100 MVA. The arcing horns shall close before the main contacts close and open after the main contacts are separated. Arcing horns shall be made of liberally rated renewable rod type. The diameter of the arcing horn’s rod shall be atleast 10 mm made out of G.I.M.S.
4.17  INTERLOCKING:

4.17.1: Each earth switch shall be mechanically interlocked with the associated isolator so as to prevent closing of the earthing blades when the main blades are in a closed position and vice-versa. The interlocking arrangement shall be strong and robust. Each isolator shall be provided with electrical interlocking (of the approved type) between isolator and associated circuit breaker so that isolator may not be operated on load, i.e. when the circuit breaker is in closed position.

4.17.2: The earth switches, wherever provided, shall be constructionally interlocked so that the earth switch can be operated only when the isolator is open and not vice-versa. The constructional interlocks shall be in-built construction of isolator and shall be in addition to the electrical and mechanical interlocks provided in the operating mechanism.

4.17.3: In addition to the constructional interlock, isolator & earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocking shall be of fail safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation on 220 V DC supply.

4.17.4: Castel type keyed switches with solenoid operated locking pin and one auxiliary contact shall be provided for the interlocking scheme. It shall not be possible to operate the isolator or earth switch manually without fitting this key on shutters provided on the openings for inserting operating crank. It shall not be possible to operate the isolator electrically unless this key is re-fitted in the switch.

4.18  INTERIOR ILLUMINATION:

A switch, HRC fuse and holder suitable for a 240V Lamp shall be provided in the Control Cabinet.

4.19  POWER SOCKET:

A single phase 240V, 15A power socket and switch shall be provided in the motor operated operating mechanisms of the isolator.

4.20  CONTROL AND AUXILIARY SUPPLY:

A three phase switch with HRC fuses for phases and link for neutral shall be provided for power supply and a 2 way switch with HRC fuses shall be provided for control supply in the motor operated mechanism of the isolator.

4.21  ACCESSORIES:

The accessories to be provided on the isolator shall include but not be limited to the following:

4.21.1:  POSITION INDICATOR:

A position indicator to show whether the isolator is in ON or OFF position.

4.21.2:  COUNTER BALANCE SPRINGS/COUNTER WEIGHTS:

Counter balance springs, cushions etc., shall be provided to prevent impact at the end of travel both on opening and closing of the isolator. The springs shall be made of durable and non-rusting type alloy. Counter weights shall be provided on the earth blades for balancing so that the operations are carried out smoothly.
4.22 NAME AND RATING PLATE:

Isolators and earth switch and their operating devices shall be provided with a name plate. The name plate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following information duly engraved or punched on it.

4.22.1: ISOLATOR BASE:

(a) Name of Purchaser:
(b) Name of Manufacturer:
(c) A/T No.:
(d) Type Designation:
(e) Manufacturer’s serial number:
(f) Rated voltage:
(g) Rated normal current:
(h) Rated Short Time Current (rms) and duration:
(i) Rated short time peak current (kAp):
(j) Weight:

4.22.2: EARTHING SWITCH:

(a) Name of purchaser:
(b) Name of Manufacturer:
(c) A/T No.:
(d) Type Designation:
(e) Manufacturer’s serial number:
(f) Rated voltage:
(g) Rated short time current (rms) and duration:
(h) Rated short time peak current (kAp):
(i) Weight:

4.22.3: OPERATING DEVICE:

(a) Name of purchaser:
(b) Name of Manufacturer:
(c) A/T No.:
(d) Type Designation:
(e) Reduction gear ratio:
(f) A.C.Motor:
   (i) Rated auxiliary voltage:
   (ii) Starting current:
   (iii) Designation of AC Motor as per IS:4722:
   (iv) Starting Torque at 80% of supply voltage:
   (v) Pretravel in degrees after cutting of supply:
(g) Total operating time in seconds:
   (i) CLOSE operation - electrical
   (ii) OPEN Operation - electrical
   (iii) OPEN Operation - manual
(h) Space Heater:
   (i) Rated voltage and power:

AUXILIARY CONTACTS:

(i) Rated current (Amps):
(ii) No. of contacts used (NC & NO):
(iii) No. of free contacts (NC & NO):
TERMINAL BLOCKS AND WIRING:

(i) Rated current:
(ii) Voltage grade and type:

4.23 PADLOCKING DEVICE:

All isolators and earthing switches shall be provided with padlocking device to permit locking of the isolator and earthing switch in both fully open and fully closed positions.

Isolators and earthing switch shall be arranged to be interlocked Electrically also.

4.24 SIGNALLING:

4.24.1: Signalling of the close position shall not take place unless the movable contact has set in a position in which the rated normal current, the peak withstand current and the short time withstand current can be carried safely.

4.24.2: Signalling of the open position shall not take place unless the movable contact has reached the position such that the clearance between the male and female contacts is at least 80% of the isolating distance.

4.25 FORK AND LIFT TYPE EARTHING BLADES:

4.25.1: The isolators controlling the transmission lines shall be equipped with earthing blades. The earth blades in the isolators shall be vertical fork and lift type with provision of reduction gear box mechanism for easy make and break operation of the earth switch and provided with counter weights for balancing. The earthing blades shall be manually operated in a similar manner to main isolator. Fixing arrangements shall be provided on the base frame of the isolators such that the earth blade can be fitted on both sides and both ends of the male and female contacts so that opening direction of the isolators can be kept the same for any combination of location of earth blade. The banging type earth switch shall not be acceptable. The earth switch shall be so designed that while operation the earth blade shall lift first and then enters the fixed contact in second stage through reduction gear mechanism.

4.25.2: Flexible copper connections shall be provided between earth blades and the frame which shall have a cross-section of atleast 200 sq.mm and shall betinned or suitably treated against corrosion.

4.25.3: The frame of each isolator and earthing switch shall be provided with two reliable earthing terminals for connections to the earthing conductor/ flat so also clamping screws suitable for carrying specified short time current. Flexible ground connections shall be provided for connecting each earthing blade and operating handle of earth switch and isolator to the earthing flat. The diameter of clamping screw shall be at least 12mm. The connecting point shall be marked with "Earth" symbol.

4.25.4: The Material of earthing blades and contacts shall be same as those of main blades and contacts respectively. The earth switch shall be type tested and cross sectional area of earthing blades and contacts shall not be less than 50% of cross sectional area of main blades and contacts respectively. The earthing blades shall have the same short time current rating (thermal and dynamic) as that of main blades. The material of components and cross section of earth switch blade shall be either exactly same or superior than that of earth switch got type tested for short circuit test. If the earth switch is not type tested than the cross sectional area of earth switch blade and contacts shall be same as of main switch.
4.26 DESIGN AND CONSTRUCTION:

Full particulars of design, manufacture, jig template and quality control devices developed for manufacture of the equipment offered in respect of but not limited to the following, shall be furnished with drawings and descriptions:

(i) Contacts, material, current density etc.
(ii) Design of contact pressure.
(iii) Contact support and fixing arrangement on isolators.
(iv) Operating mechanism, clamps, locks etc.
(v) Bearings, housing of bearings, bushes etc.
(vi) Balancing of heights.
(vii) Coupling pipes, joints, connection adjustments.
(viii) Base plates.
(ix) Down pipe guides and joints.
(x) Brass bushes and bearings at various joints.
(xi) Operating mechanism, type of gear, aux. switch, size and thickness of box, degree of protection, gland plate, gland etc.
(xii) Nuts, bolts and fasteners.
(xiii) Interlocking devices.

4.27 FASTENERS:

All the bolts, nuts, washers etc. required for assembling the equipment and for fixing them on the structures including for fixing of post insulators on the base plate/base frame are included in the scope of supply. Nuts, bolts and washers of 5/8” and higher size shall be hot dip galvanised. Nuts, bolts and washers of less than 5/8” size shall be of stainless steel when used on current carrying live parts and nickel plated brass in other parts.

4.28 CONTACTS:

4.28.1: The contacts, terminal arrangement and terminal pad of the isolator shall be made out of hard drawn electrolytic copper having liberal cross section to withstand the rated normal current and fault levels. The contacts of isolators shall be reverse loop type, heavy duty, self aligning, high pressure contacts of modern design. The contacts surface shall be silver plated having minimum thickness of 40 microns. The switch blades shall be made from tubular section of hard drawn electrolytic copper having suitable diameter and wall thickness. The contact surface shall be wiped during closing and opening operations to remove any film, oxide coating etc. Wiping action shall not cause scouring for abrasion of surfaces. Fabrication of contact shall be made with suitable jig to avoid deviations during production. Details of size & shape of contacts, springs, back plate, fixing arrangements design of contact pressure, life of contacts, limit of temperature rise etc, shall be furnished by the manufacturer. The moving contacts of tubular section shall be so dimensioned as to carry the rated current. Bi-metallic strip of 1 mm thickness shall be used for all connections between copper and aluminium parts.

4.28.2: The current density shall be less than 1.6 A per sq. mm in the male and female contacts & terminal pad. The current density in all other parts of Isolator shall be less than 2.5 A/sq. mm for copper and 1.0 A/sq. mm in Aluminium. The supporting calculation showing current density without & with holes for overlapping shall be furnished.

4.28.3: The male and female contacts assemblies and blades should ensure:

(i) Electrodynamic withstand ability during short circuit.
(ii) Thermal withstand ability during short circuit.
(iii) Constant contact pressure even when the live parts of the insulator stack are subject to tensile stresses due to linear expansion of connected bus bar or flexible conductor either because of temperature variation or strong winds.
4.29 MOUNTING OF FIXED CONTACTS:

The fixed contacts shall be mounted on a block or channel welded to 10 mm thick M.S. plate with holes for fixing on insulators. Slots shall be provided for marginal adjustment of height of contacts. Suitable device shall be provided to prevent dashing. Fabrication, welding etc. shall be done in suitable jig to avoid deviations during production. The fixed and moving contact arms shall be fitted on the post insulators for which purpose the fixing plates shall have four tapped holes of 16 mm diameter at 127 mm PCD.

4.30 TERMINAL ARRANGEMENT:

The terminal of isolators shall be connected to the fixed contacts. The terminal shall be made out of hard drawn electrolytic copper and shall have minimum cross-section of 1250 Sq. mm. The terminal pad shall be suitable for connection to aluminium connector through bimetallic strip. The terminal arrangement for connection shall be suitable for horizontal and vertical take off.

4.31 TERMINAL CONNECTORS (2000 Amp.):

4.31.1: Each isolator shall be provided with 2000 Amp. bi-metallic rigid self grooved bolted type Terminal Connectors suitable for Twin & Single AL-59 (Moose equivalent) conductor for 245KV Isolators. The Terminal Connector shall be suitable both for horizontal and vertical take off. The conductor spacing for Twin AL-59 (Moose equivalent) conductor shall preferably be 300 mm. The Terminal Connectors shall have ratings as that of isolator's current rating or higher. The current density in Terminal Connectors shall not exceed 1.0 Amp/Sq. mm.

4.31.2: The Terminal Connectors shall meet the following requirements:

(i) The Terminal Connectors shall be designed most liberally for current ratings and shall be manufactured and tested as per IS:5561 for tensile strength, temperature rise and Short Circuit current withstand test.
(ii) All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
(iii) No part of clamp shall be less than 10 mm in thickness.
(iv) All ferrous parts shall be of stainless steel.
(v) For bimetallic connectors, copper alloy linear of minimum thickness of 2 mm shall be cast integral with aluminium body.
(vi) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
(vii) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS:5561.

4.31.3: The bimetallic strip of standard quality having thickness of at least 2 mm shall be used to avoid galvanic corrosion.

4.32 ASSEMBLY:

The isolator shall be fully assembled at the works of the supplier and operations shall be carried out on it to ascertain that all parts fit correctly and function satisfactorily.

4.33 TEMPERATURE RISE:

The temperature of the moving blades, contacts, terminal arrangement, terminal pad and Terminal Connectors and other parts of the isolator shall not exceed the limits as specified in the IS:9921
while carrying full load current at maximum ambient temperature of 50 degree C and other site
conditions as mentioned in the specification instead of an ambient temperature of 40 degree C as
mentioned in relevant IS.

5.0 TYPE TESTS:

5.1: Certified copies of complete type test reports of all tests as per IS:9921 (Part-IV) including Short Circuit current withstand test on Earth Switch alongwith certified drawings clearly showing the material components and cross sectional area of all current carrying parts shall be furnished with the confirmation that material components and cross sectional area of all current carrying parts will be either exactly same or superior than that of isolators got type tested of which type test reports are being furnished.

5.2: The type test reports of Terminal Connectors as per IS:5561, Degree of protection test on Enclosure as per IS:13947 and test on Auxiliary Switch as per relevant IS alongwith the certified drawings shall also be furnished.

6.0 INSPECTION AND TESTING:

The following routine and acceptance tests as per relevant standards shall be got conducted in presence of purchaser’s representative:

(i) Voltage test on control and auxiliary circuit of isolators as per IS:9921 (Part.IV) on all offered isolators.

(ii) Measurement of resistance of main circuit of isolator as per IS:9921 (Part.IV) on all offered isolators.

(iii) Mechanical Operation test on one isolator of each type & rating with available post insulators selected at random out of each offered lot for inspection.

(iv) Mechanical Endurance test shall be done as acceptance test on one isolator of each type and rating with available post insulators selected at random out of each offered lot for inspection. Mechanical endurance test shall be conducted on the main switch as well as earth switch of one isolator of each type and rating. Damaged contacts shall not be acceptable in any case. The contacts of isolators which have undergone this test shall be silver plated again by the supplier before despatch.

(v) Verification of dimensions as per approved drawings/Schedule of Guaranteed Technical Particulars on one Isolator of each type and rating selected at random out of each offered lot for inspection.

(vi) Temperature rise test after fitting Terminal Connectors on one selected Isolator out each offered lot for inspection. The test shall be carried out at maximum ambient Temp. specified in specification instead of 40 Deg. C as mentioned in relevant IS.

(vii) The galvanised components shall be tested for preece test as per IS:2633 of one Isolator of each type & rating selected at random out of each offered lot for inspection.

(viii) The thickness of silver plating as per BS:2816 at supplier’s works or at independent Govt. approved testing house on one piece (either moving or fixed contact) of isolator of each type & rating selected at random out of each offered lot for inspection.

7.0 GUARANTEE PERIOD:

All the Isolators to be supplied under this contract shall be guaranteed for a period of 12 Months from the date of their commissioning or 18 Months from the date of receipt of last consignment of isolators at site, whichever is earlier.
TECHNICAL SPECIFICATION OF 33KV, 2500A & 1250A, DOUBLE BREAK, BANGING TYPE ISOLATORS

1.0 SCOPE:

The specification covers design, manufacture, assembly, testing at manufacturer's works, packing and delivery with accessories and auxiliary equipments of 33 KV, 2500 A & 1250 A Isolators with & without Earth Switch.

It is not the intent to specify completely herein all details of the design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous operation. The Purchaser will interpret in a manner the meaning of drawings and specifications and shall have the power to reject any work or material which in his judgment is not in accordance herewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation alongwith associated equipments, interlocks, protection schemes etc. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification. All similar parts particularly movable ones shall be interchangeable.

1.1 STANDARDS:

The Isolators with their accessories and fittings shall conform to the latest editions of the following standards (as amended upto date) except where specified otherwise in this specification.

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2.0 PRINCIPAL PARAMETERS:

2.1 The equipment covered in this specification shall meet the technical requirements listed below:

(A) Particulars of system:

- (i) Nominal system voltage - 33 KV rms
- (ii) Highest system voltage - 36 KV rms
- (iii) Rated frequency - 50 Hz
- (iv) No. of phases - 3 Nos.
- (v) System Neutral Earthing - Effectively Earthed.
(B) Climatic conditions: As specified in Specification.

(C) Characteristics of Isolator: The values of the Parameters/Particulars mentioned below shall not be less than the specified against each:

1. Number of poles. : 3 Nos.
2. Class : Out door
3. Rated voltage : 36 KV rms
4. Operating Mechanism : Manual Operated
5. Type of Isolator : Triple pole, gang operated, double break, central post rotating.
6. Rated insulation level:
   (a) Lightning impulse withstand voltage:
      (i) To earth & between poles. : 170 KV Peak
      (ii) Across the isolating distance : 195 KV Peak
   (b) One minute P.F. withstand voltage:
      (i) To earth & between poles. : 70 KV rms
      (ii) Across the isolating distance : 80 KV rms

7. Rated normal current under climatic conditions specified. : 2500 Amp & 1250 Amp

8. (i) Rated short time withstand current for one second : 31.5 KA rms
   (ii) Rated peak withstand current : 78.75 KA rms

2.2 Specific Technical Requirements:

1. Phase to Phase separation (Centre to Centre) : 1500 mm (Min.)
2. Minimum centre to centre distance between two
3. Size of base channel on which insulators are to be mounted. : 100x50 mm
4. Size of vertical operating pipe (Down pipe):
   (i) Length : 2 Meter
   (ii) Nominal bore : 25 mm
5. Minimum length of operating handle : 500 mm
6. Min. nominal bore of phase coupling pipe : 20 mm
7. Minimum cross-sectional area of terminal pad : 782 Sq.mm
8. Minimum cross-sectional area of fixed contacts : 593 Sq.mm
9. Minimum Nos. of fingers in a fixed contact : 2 pairs.
10. Diameter of Arcing Horn (Rod) : 10 mm
11. Size of flexible earthing connector:
   (i) Minimum cross-sectional area. : 160 Sq.mm
   (ii) Length. : 150 mm
12. Name of conductor for which Electric power connector shall be suitable : Twin & Single Tarantula
13. Minimum number of guides to be provided for down pipe. : 2 Nos.
14. Minimum size of bimetallic strip to be provided between Aluminium terminal connector and : 75 mm x 75 mm x 1mm
copper terminal pad.

15. Top & bottom pitch circle diameter of Post Insulator stack: 76 mm

16. Number of minimum size of bolts to be provided for fixing terminal connector with terminal pad: 4x3/8” dia

17. Number & rating of auxiliary contacts:
   (i) For Isolators: 4NO+4NC
   (ii) For earth switch: 2 NO+2NC
   (iii) Rated supply voltage: 220V DC; 230V AC, 1-PH
   (iv) Rated current: 10 Amps

18. Min. thickness of silver coating on contacts: 40 Microns

3.0 GENERAL TECHNICAL REQUIREMENTS:

3.1 DESCRIPTION OF THE EQUIPMENT:

3.1.1: The Isolators (Hardwares) shall be constructed out of the best quality of material suitable for weather conditions specified in the specification. The workmanship shall be of the highest grade and the entire manufacture shall be in accordance with the modern engineering practices. All ferrous parts shall be given an anticorrosive finish and shall be hot dip galvanised. The other parts shall be substantially non corrosive. The bearings in the current path shall be shunted by flexible copper connectors of adequate cross section and the bearing housings shall be completely weather proof with arrangement to facilitate the lubrication of the bearings.

3.1.2: The Isolators shall be triple pole, gang operated, double break, three post type with central post rotating, banging type suitable for outdoor horizontal mounting. The Isolators shall be manual operated. The operating handle shall have arrangement for locking Isolators/earth switch in ‘ON’ and ‘OFF’ positions.

3.1.3: For reasons of safety, the switch isolator should be so designed that no dangerous leakage current can pass from the terminals of one side to any terminals of the side of the switch Isolator.

3.1.4: The frame of each Isolator shall be provided with reliable earthing terminal for each phase for connection to an earthing conductor having a clamping bolt of not less than 12mm diameter. The terminal shall be marked with ‘Earth’ symbol. The earthing of operating handle shall be made through flexible copper strip of adequate cross section connected to the supporting metallic structure.

3.1.5: The isolators shall be provided with arcing horns of liberally rated renewable type with make before and break after arrangement. The arcing horns shall be made of G.I. Rod.

3.1.6: All similar material and removable parts of similar equipment shall be interchangeable with each other.

3.1.7: The vertical operating pipe and phase coupling pipe shall be of galvanised mild steel tube (medium class) as per IS-1161.

3.1.8: Suitable arrangement shall be provided to padlock the operating handle of isolating switch in ‘ON’ & ‘OFF’ positions.

3.1.9: All ferrous parts shall be hot dip galvanised and uniformity of zinc coating shall satisfy requirement of IS-2633. The pipes/tubes shall be galvanised in accordance with IS-4736.
3.1.10: All contacts points shall be silver plated and their temperature rise shall be governed as per surface conditions. The current density shall be less than 2.5 Amps per Sq. mm in copper, or minimum cross-sectional area shall be as specified.

3.1.11: The guide cum locking plate near the operating handle shall have two holes (1/4") at a distance of 70 mm for fixing the plate.

3.2 BASE CHANNELS:

The channels shall be of sizes mentioned above in "Principal parameters" and shall conform to IS-808.

3.3 BEARINGS:

3.3.1: The bearing assembly for each rotating central post shall have taper thrust roller bearing at top & ball bearing at the bottom/other end of bearing housing. The entire mechanical load shall be suspended on thrust bearings. The bearings shall be of reputed make.

3.3.2: The vertical operating shaft shall be supported with taper thrust roller bearing on the top and atleast two guides in between at uniform interval alongwith its length in order to ensure smooth and easy operation.

3.3.3: A galvanised MS Angle/channel of suitable length shall be provided for fixing of forth bearing assembly. The holes provided shall be movable type and equal distance to that of base channel holes.

3.4 OPERATING MECHANISM:

3.4.1: The three phase 33 KV isolators shall be manually controlled from the Switch yard. The manual operating handle shall be at a height of 1150 mm from the ground level (Including plinth). Additional electromagnetic type interlock shall be provided on the manual operating handle so as to prevent the operation of isolator manually or electrically when the corresponding circuit breaker is ON. Suitable interlock shall be provided.

3.4.2: The design of manual operation shall be such that one man shall be able to operate the isolator without undue effort. The operating mechanism shall be suitable to hold the disconnector in CLOSE or OPEN position and prevent operation by gravity, wind, Short Circuit forces, seismic forces, vibration, shock, accidental touching etc.

3.5 CONTROL BOX:

The control box of the operating mechanism shall be made out of 12 SWG hot dip galvanized sheet steel and shall be weather and dust proof. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP-55 as per IS:13947. Separate cabinet made out of 12 SWG hot dip galvanized sheet steel shall be provided with each earth switch operating mechanism. The cabinet for both main and earth switch shall be mounted on galvanized support structure with adjustment for horizontal and vertical alignment. The support structure with suitable hardware is also in the scope of supply.

3.6 BOLTS, NUTS & WASHERS:

All bolts, nuts and washers required for assembling the equipment and for fixing them on to the structure shall be galvanised and shall be supplied with the equipment.
3.7 CLEARANCES:

The isolators shall have clearances conforming to relevant IS and should meet the requirements of the impulse voltage test as specified therein.

3.8 TEMPERATURE RISE:

3.8.1 The equipment covered by this specification shall be used outdoor and maximum temperature attained by any part of the equipment in service at site conditions and full load current shall not exceed the permissible limits mentioned in IS:9921 at maximum ambient temperature of 50 degree centigrade.

3.8.2 The temperature rise test after fitting terminal connectors shall also be carried out as routine test on one switch isolator out of each lot offered for inspection. The limit shall not exceed those specified under this specification.

3.9 TESTS:

3.9.1 TYPE TESTS:

3.9.1.1: The Isolators and Earthing Switches shall be Type tested for all tests as per IS:9921 (Part.IV) alongwith certified drawings clearly showing the material components and cross sectional area of all current carrying parts with the confirmation that material components and cross sectional area of all current carrying parts will be either exactly same or superior than that of Isolators got type tested of which type test reports shall be furnished.

3.9.1.2: The type test reports of terminal connectors as per IS:5561, Degree of protection test provided by enclosure as per IS:2147/13947 alongwith certified drawings shall be furnished.

3.10 INSPECTION AND TESTING: Acceptance and Routine Tests:

(i) All routine/acceptance tests as per relevant standards including dimension check shall be carried out on 10% quantity of lot offered for inspection except for the following test:

(a) High voltage power frequency voltage withstand test with insulators.
(b) Mechanical operation test. The mechanical operation test shall be carried out on only one sample of isolator selected at random from 10% lot.

(ii) The following tests shall also be carried out on one sample isolator:

(a) Mechanical endurance test. The test shall be done on one isolator selected at random from each offered lot for inspection.
(b) Temperature rise test after fitting terminal connectors on one isolator selected at random from each offered lot for inspection.
(c) The galvanised components shall be tested for preece test as per IS:2633 on one isolator selected at random from each offered lot for inspection.
(d) The silver plating thickness shall be tested as per provision of BS:2816 on one piece (either moving or fixed contact) selected at random from each offered lot for inspection. The testing shall be carried at either supplier’s works or at independent approved testing house.

3.11 GUARANTEE PERIOD:

All the isolators to be supplied under this contract shall be guaranteed for a period of 12 Months from the date of their commissioning or 18 Months from the date of receipt of last consignment of isolators at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 245 KV SOLID CORE POST INSULATOR STACKS

1.0 SCOPE:

This specification covers the design, engineering, manufacture, assembly, inspection and testing at manufacturer’s own works with all fittings and accessories of 245KV Solid Core Post Insulators required for 245KV, 2000 Amps. outdoor Gang operated Isolators and also as support Insulators.

It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous operation. The purchaser will interpret in a manner the meanings of drawings and specification and shall have the power to reject any work or material which in his judgment is not in accordance herewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of supply irrespective of whether these are specifically brought out in this specification or not.

2.0 STANDARDS:

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of 245KV Solid Core Post Insulators shall conform to the IS: 2544 & IS: 5350 (Part-II) with latest amendments. Equipment meeting with the requirements of other authoritative National or International Standards, which ensure equal or better performance than the standards mentioned above, will also be acceptable. When the equipment offered by the bidder/supplier conforms to other standards, salient point of difference between standards adopted and the standards specified in this specification shall be clearly brought out. Two copies of such standards with authentic translation in English shall be furnished.

3.0 RATING:

The rating of 245 KV Gang operated isolators for which 245 KV Solid Core Post Insulators are required shall be as under:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>245KV Isolator</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>No. of poles</td>
<td>3</td>
</tr>
<tr>
<td>(ii)</td>
<td>Nominal system voltage</td>
<td>220 KV rms.</td>
</tr>
<tr>
<td>(iii)</td>
<td>Rated voltage</td>
<td>245 KV rms.</td>
</tr>
<tr>
<td>(iv)</td>
<td>Rated frequency</td>
<td>50 Hz.</td>
</tr>
<tr>
<td>(v)</td>
<td>One minute power frequency withstand voltage</td>
<td>460 KV rms.</td>
</tr>
<tr>
<td>(vi)</td>
<td>Impulse withstand voltage</td>
<td>1050 KV peak.</td>
</tr>
</tbody>
</table>

4.0 TYPE OF INSULATORS:

4.1: 245KV Solid Core Outdoor Post Insulators used with 245KV Isolators shall be cylindrical type.

The 245KV Solid Core Post Insulators shall be conforming to latest edition of relevant IS. The porcelain and metal parts shall be assembled together in such a manner that due to expansion between metal and the porcelain part throughout a range of temperature variation, it shall not loosen the parts or create undue stresses adversely effecting performance of insulators for various electrical and mechanical properties.
4.2: The minimum desirable electrical and mechanical values of 245KV Solid Core Post Insulators shall be as given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>245KV values</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Torsional strength</td>
<td>460 Kgf-m.</td>
</tr>
<tr>
<td>(ii)</td>
<td>Cantilever strength</td>
<td>612 Kgf.</td>
</tr>
<tr>
<td>(iii)</td>
<td>Tensile strength</td>
<td>7000 Kgf.</td>
</tr>
<tr>
<td>(iv)</td>
<td>Compression strength</td>
<td>27000 Kgf.</td>
</tr>
<tr>
<td>(v)</td>
<td>Dry Power frequency withstand</td>
<td>460 KV rms.</td>
</tr>
<tr>
<td>(vi)</td>
<td>Wet power frequency withstand</td>
<td>460 KV rms.</td>
</tr>
<tr>
<td>(vii)</td>
<td>Impulse withstand voltage</td>
<td>1050 KV peak.</td>
</tr>
<tr>
<td>(viii)</td>
<td>Visible discharge voltage</td>
<td>154 KV rms.</td>
</tr>
<tr>
<td>(ix)</td>
<td>Total minimum creepage distance</td>
<td>6125 mm.</td>
</tr>
<tr>
<td>(x)</td>
<td>No. of insulator per stack (max.)</td>
<td>Two</td>
</tr>
<tr>
<td>(xi)</td>
<td>Post insulator height</td>
<td>2300 mm.</td>
</tr>
<tr>
<td>(xii)</td>
<td>Height of bottom metal fitting (min.)</td>
<td>90 mm</td>
</tr>
<tr>
<td>(xiii)</td>
<td>Fixing arrangement for Terminal Connector at top</td>
<td>4 Nos. tapped M16 holes at 127mm PCD</td>
</tr>
<tr>
<td>(xiv)</td>
<td>Bottom metal fitting PCD</td>
<td>4 Nos. of 18mm dia. holes at 225mm PCD</td>
</tr>
</tbody>
</table>

5.0 TYPE TESTS:

The 245KV Solid Core Post Insulators shall be fully type tested as per IS:2544 and IS:5350 (Part-II). The bidder/supplier must furnish valid type test reports as per IS:2544 and IS:5350 (Part-II) of similar rating and design of material/equipment with certified drawings tested in a Govt./Govt. approved/Govt. recognized/NABL accredited test laboratory in India, including the following tests for mechanical strength. These test reports should not be older than 7 years as on the date of opening of technical bid for which the date of conducting the test shall be considered:

(i) Bending Test.  
(ii) Tensile Test.  
(iii) Torsional Test.  
(iv) Compression Test.

6.0 INSPECTION AND TESTING:

6.1 ROUTINE/ACCEPTANCE TESTS:

(i) All the routine/acceptance tests as per relevant standards shall be got conducted in presence of RSDCL's representative on each lot offered for inspection.

(ii) Beside above, the type tests for mechanical strength (i.e. bending, tensile, torsional and compression tests) shall be got conducted in presence of purchaser's representative on each lot offered for inspection.

Sampling shall be done as per the provisions of relevant ISS. However, if the quantity of offered lot for inspection is less than or upto 500 Stacks, the sample size for carrying out the above tests shall be as under:

(i) Upto and including 300 Stacks. - 2 Stacks.  
(ii) 300 to 500 Stacks - 4 Stacks.
6.2: All the tests and inspection shall be made at the place of manufacturer unless otherwise especially agreed upon.

6.3: Inspection and acceptance of any material under the specification by the purchaser shall not relieve the supplier/contractor of his obligation of furnishing material in accordance with the specification & shall not prevent subsequent rejection, if the material is found to be defective. The supplier/contractor shall keep the purchaser informed in advance about the manufacturing programme so that arrangements can be made for inspection.

7.0 DRAWINGS:

The bidder/supplier shall submit the fully dimensional drawing of 245KV Solid Core Post Insulator to be supplied by him alongwith photocopy of complete type test certificates/ reports with certified drawings showing full details of post Insulators got type tested in order to enable the RSDCL to ascertain the clearance etc. The dimensions of upper and lower metal fitting shall be clearly shown in the drawings of insulator offered. The following drawings are to be furnished by the bidder/supplier:

(i) Outline dimensional drawings of post Insulator alongwith complete details regarding metal hardware fittings.
(ii) Assembly drawings and weight of main component/part.
(iii) Drawings showing dimension of upper and lower metal parts alongwith PCD.
(iv) Descriptive literature and manufacturing data on insulator shall be furnished.

8.0 MARKING AND PACKING:

(1) Each Post Insulator unit shall be legibly and indelibly marked to show the following:

   (i) Name and trade mark of manufacturer.
   (ii) Month and year of manufacture.
   (iii) Country of manufacture.

   Such marking on porcelain shall be printed, not embossed and shall be applied before firing. Post Insulator may be marked with the ISI certification mark.

(2) All Post Insulators shall be packed in strong wooden boxes of approved design with hoops and bonds for strength and durability to withstand rough handling during shipment, transport and also during storage.

(3) Each consignment shall be accompanied by a detailed packing list containing the following information:

   (i) Name of the consignee.
   (ii) Details of consignment.
   (iii) Destination.
   (iv) Handling and unpacking instruction.
   (v) Bill of material indicating contents of each package.

9.0 COMPLETENESS OF EQUIPMENT:

All fittings and material etc. which may have not been specifically mentioned in this specification but which are usual or necessary for the equipment shall be deemed to have been included in this specification. All equipment shall be complete in all respect.
TECHNICAL SPECIFICATION FOR OUTDOOR INSULATORS (2 x 24 KV)

1.0 SCOPE:

This specification covers the design, manufacture, testing at manufacturer's works before despatch of outdoor post insulator units with complete fittings suitable for 33 KV Isolators.

2.0 STANDARDS:

The design/manufacture and testing of various equipments covered by this specification shall comply with the latest issue of the following standards except the value(s) wherever specified herein shall be considered relevant.

(i) IS:2544/1973 with latest amendments if any.
(ii) IS:5350 (Part.III/1971) with latest amendments if any.

Post insulator and/or post insulator unit conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above, would be acceptable. In case the bidders wish to offer equipment conforming to other standards, they shall furnish an English Translation of the relevant standards.

3.0 CONSTRUCTIONAL DETAILS:

3.1 GENERAL:

The post insulator units shall be constructed out of the best quality of material suitable for weather conditions as prevailing in Rajasthan. The workmanship shall be of the highest grade and the entire manufacture shall be in accordance with the modern Engineering practices. All ferrous parts shall be given an anticorrosive finish and shall be hot dip galvanized. The other parts shall be substantially non corrosive.

3.2: The stack of two units of 24 KV Post Insulator shall be used for 33 KV Isolators. The rating of individual post insulator shall not be less than 24 KV for 33 KV Isolators.

3.3: The porcelain used for post insulators shall be sound, free from defects, thoroughly vitrified smoothly glazed. The glaze shall be brown in colour. The glaze shall cover all the exposed porcelain parts of the insulator except those areas which serve as support during fixing are required to be left unglazed.

3.4: The porcelain and metal parts shall be assembled in such a manner that any thermal expansion between the metal parts and porcelain shall not get loose or create undue strength adversely affecting the mechanical and electrical strength of the unit as a whole or stack of two units.

3.5: Cement used in the construction of post insulators shall not cause fracture by expansion or loosening by construction and proper care shall be taken to locate correctly the individual parts during cementing. The cement used shall not give rise to chemical reaction with metal fittings, and its thickness shall be uniform.

3.6: The porcelain and hardware surface coming in contact with cement shall be coated with bituminous paint for cushioning to relieve mechanical stress caused by temperature variation and cement expansion.

3.7: All ferous metal parts, except those of stainless steel, shall be hot dip galvanized and the uniformity of the zinc coating shall satisfy the requirement of IS:2633/1972 with latest edition. The finished galvanized surface shall be smooth.
3.8: The threads of the tapped holes in the post insulator metal fittings shall be cut after giving anti corrosion protection and shall be protected against rust by greasing or other similar means, all other threads shall be cut before giving anti-corrosion protection. The tapped holes shall be suitable for bolts with threads having anti-corrosion protection and shall conform to IS:4218 (Part-I to IV)/1967 or latest version thereof. The effective length of thread shall not be less than the nominal diameter of the bolt.

3.9: The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fitting shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and the bottom metal fitting shall be in a vertical plane containing the axis of the insulator.

3.10: The post insulators shall conform to IS:5350 (Part.III/1971). 24KV Insulator to be used for 33KV Isolator shall be with 430 mm Minimum creepage.

4.0 TECHNICAL REQUIREMENT OF POST INSULATORS:

The standard insulation level of the post insulator unit shall be in accordance with the following:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>For 33 KV Isolators for individual unit of a stack (2 x 24 KV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Highest system voltage</td>
<td>24 KV (rms)</td>
</tr>
<tr>
<td>2.</td>
<td>Visible discharge test</td>
<td>18 KV (rms)</td>
</tr>
<tr>
<td>3.</td>
<td>Dry one minute power frequency test voltage</td>
<td>55KV (rms)</td>
</tr>
<tr>
<td>4.</td>
<td>Wet one minute power frequency test voltage</td>
<td>55KV (rms)</td>
</tr>
<tr>
<td>5.</td>
<td>Power frequency puncture withstand voltage</td>
<td>1.3 times the actual dry flush over voltage of the unit (rms.)</td>
</tr>
<tr>
<td>6.</td>
<td>Impulse voltage withstand test</td>
<td>125 KV (Peak)</td>
</tr>
</tbody>
</table>

4.1 DIMENSIONAL CHARACTERISTICS OF POST INSULATORS:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>For 33 KV Isolators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nominal system voltage</td>
<td>33 KV</td>
</tr>
<tr>
<td>2.</td>
<td>No. of units per stack</td>
<td>Two</td>
</tr>
<tr>
<td>3.</td>
<td>Total height of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Stack.</td>
<td>508 mm</td>
</tr>
<tr>
<td></td>
<td>(b) Unit.</td>
<td>254 mm</td>
</tr>
<tr>
<td>4.</td>
<td>Diameter of Insulating part (Max.)</td>
<td>210 mm</td>
</tr>
<tr>
<td>5.</td>
<td>Minimum creepage distance of each unit:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Total.</td>
<td>430 mm</td>
</tr>
<tr>
<td></td>
<td>(b) Protected.</td>
<td>215 mm</td>
</tr>
<tr>
<td>6.</td>
<td>Top and bottom fitting pitch circle diameter</td>
<td>76 mm</td>
</tr>
</tbody>
</table>

5.0 DRAWINGS:

The following drawings/technical literatures of the equipment shall be furnished by the bidders.

(i) Outline dimensional drawings of insulators.
(ii) Assembly drawings showing complete details of all parts and separating mechanism and mass of main components.
6.0 MARKING:

(i) Each post insulator or post insulator unit shall be legibly and indelibly marked to show the following:

(a) Name or trade mark of the manufacturer.
(b) Month and year of manufacture.
(c) Country of manufacture.

(ii) Marking on porcelain shall be printed and shall be applied before firing.

(iii) Post insulator or post insulator unit may also be marked with the ISI certification mark.

7.0 TESTS:

7.1 TYPE TESTS:

The 2x24 KV Post Insulator stack shall be fully type tested as per IS:2544 and IS:5350 (Part-III). The tenderer must furnish type test reports with certified drawings, conducted in a Govt./Govt. approved/NABL test lab on similar rating & design of material/equipment.

7.2: Each equipment shall comply with and shall be subjected to all routine tests prescribed in the relevant Indian Standard Specification.

7.3: The various acceptance tests as per relevant standards shall be carried out on required number of samples (but not less than 6) covered by this specification in the presence of purchaser's representative.

The purchaser has right to have the test carried out at his own cost by an independent agency wherever there is dispute regarding the quality of material.

8.0 COMPLETENESS OF EQUIPMENT:

All fittings, accessories or apparatus which may have not been specifically mentioned in this specification, but which are usual or necessary for the equipment shall be deemed to have been included in this specification. All equipments shall be complete in all respects.
TECHNICAL SPECIFICATION OF 198KV (HEAVY DUTY) STATION CLASS SURGE ARRESTERS (LIGHTNING ARRESTERS)

1.0 SCOPE:

This specification covers design, manufacture, assembly testing at manufacturer’s works of 198 KV (HEAVY DUTY) station class metal oxide surge Arresters. The surge Arresters shall be complete in all respects conforming to modern design and practice for protection of transformers and substation equipments of 3 phase 50Hz solidly grounded neutral AC system. The surge arresters are required for 220KV system protection. The surge arresters for 220KV system are to be provided with insulating base and surge counter with current meter. All accessories & fittings shall also be in the scope of contractor.

The arrester housing shall be porcelain/ polymer as per IEC standard.

2.0 STANDARDS:

The surge arresters shall conform to the latest editions and amendments available at the time of supply, of the standards listed hereunder.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Standard Ref. No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IEC 99-4</td>
<td>Specification Part-4 for surge Arrestors without gap for AC system.</td>
</tr>
<tr>
<td>3.</td>
<td>IS:2629</td>
<td>Recommended practice for hot dip galvanising of iron and steel.</td>
</tr>
<tr>
<td>4.</td>
<td>IS:2633</td>
<td>Method for testing uniformity of coating on zinc coated articles.</td>
</tr>
<tr>
<td>5.</td>
<td>IS:5621</td>
<td>Specification for large hollow porcelain for use in electrical installation.</td>
</tr>
<tr>
<td>6.</td>
<td>IS:2147</td>
<td>Degree of protection provided by enclosures for low voltage switchgear and control.</td>
</tr>
</tbody>
</table>

Note: (i) For the purpose of this specification, all technical terms used hereinafter shall have the meaning as per IEC specification.
(ii) For the parameters of the Arrestor which are not specified in IEC specification for Surge Arrestors, the provisions of BIS/3070 (Part-3) shall be applicable.

3.0 PARTICULARS OF THE SYSTEM:

The arresters shall be used on 3 phase, 50 cycles & effectively grounded neutral AC system. The maximum system voltage for 220 KV system shall be 245 KV (rms). The system frequency may vary by +3% from normal of 50 Hz.

4.0 IMPULSE WITHSTAND VOLTAGE OF EQUIPMENT AND TRANSMISSION LINES:

The basic insulation level of Transformers, Circuit Breakers and other equipments like instrument transformers and transmission lines for 220 KV systems shall be 1050KVp.

5.0 TYPE AND RATING OF SURGE ARRESTERS:

The surge arresters should be of single pole having multi units of outdoor self supporting type, heavy duty station class for 220KV system. The surge arrester shall have nominal discharge current of 10KA and voltage rating of 198 KV (rms) for 220kV systems.
6.0 CHARACTERISTICS:

The surge arresters shall generally conform to IEC-99-4 (latest addition). The surge arrester shall be suitable for the system parameters (equipment/lines) as mentioned in the specification & shall be capable of repeated successive operations for discharging the transmission lines while conducting for limiting switching surge and shall be capable of satisfactory operation within stipulated limits against surge and switching surges.

The guaranteed duration for which the arresters can be temporarily subjected to atleast 10% power frequency over voltage without affecting their operating properties shall be clearly stated.

The design features, type test certificates and other documentary evidence in support of above features of the arresters shall be furnished. The power frequency over voltage and its duration to which the arrester offered can be subjected without affecting any of its operating properties shall be explicitly guaranteed by the bidder/supplier.

The equipment offered under this specification for gapless metal oxide type station class LAs shall be suitable for the parameters as mentioned below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARAMETERS</th>
<th>220KV SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Rated voltage KV (rms)</td>
<td>198</td>
</tr>
<tr>
<td>2)</td>
<td>Nominal system voltage KV (rms)</td>
<td>220</td>
</tr>
<tr>
<td>3)</td>
<td>Max.system voltage KV(rms)</td>
<td>245</td>
</tr>
<tr>
<td>4)</td>
<td>Max. continuous operating voltage (MCOV)</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td>not less than KV(rms)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td>Nominal discharge current. KA</td>
<td>10</td>
</tr>
<tr>
<td>6)</td>
<td>Long duration discharge class</td>
<td>3</td>
</tr>
<tr>
<td>7)</td>
<td>Type of construction for 10KA rated arrester</td>
<td>Single col., Single phase.</td>
</tr>
<tr>
<td>8)</td>
<td>Min. energy discharge Capability (KJ/KV).</td>
<td>4</td>
</tr>
<tr>
<td>9)</td>
<td>Safe fault current (KA)</td>
<td>40</td>
</tr>
<tr>
<td>10)</td>
<td>Lightning impulse withstand voltage with</td>
<td>1050</td>
</tr>
<tr>
<td></td>
<td>1.2/50 micro sec. wave (KVP).</td>
<td></td>
</tr>
<tr>
<td>11)</td>
<td>One minute power frequency withstand voltage</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>of housing (dry/weight)- KV (rms).</td>
<td></td>
</tr>
<tr>
<td>12)</td>
<td>High current short duration impulse withstand</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>level with 4/10 microsecond wave KA (peak)</td>
<td></td>
</tr>
<tr>
<td>13)</td>
<td>Minimum pressure relief current (KA rms).</td>
<td>40</td>
</tr>
<tr>
<td>14(A)</td>
<td>Terminal Connector suitable for conductor size</td>
<td>Single AL-59 (Moose equivalent)</td>
</tr>
<tr>
<td>14(B)</td>
<td>Take off (for both Vertical &amp; Horizontal)</td>
<td>Yes</td>
</tr>
<tr>
<td>15)</td>
<td>Voltage (Corona extinction) (KV rms)</td>
<td>Rated Voltage</td>
</tr>
<tr>
<td>16)</td>
<td>Maximum radio interference voltage when</td>
<td>2500</td>
</tr>
<tr>
<td></td>
<td>energized at MCOV (Micro-volts)</td>
<td></td>
</tr>
<tr>
<td>17)</td>
<td>Whether insulating base and discharge counter</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>with mili-ammeter are required</td>
<td></td>
</tr>
<tr>
<td>18)</td>
<td>Min. creepage distance of Arrestor housing (mm)</td>
<td>6125</td>
</tr>
</tbody>
</table>

7.0 ACCESSORIES AND FITTINGS:

7.1 PORCELAIN HOUSING:

(a) All porcelain housings shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths.
(b) The porcelain shall be well vitrified and non porous.
(c) The creepage distance of the Arrestor housing shall be as mentioned above.
(d) The porcelain petticoat shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc., shall be indicated by the Bidder.
(e) The Arrestor housing shall conform to the requirements of IEC specification.

7.2 POLYMERIC HOUSING:

(a) The silicon polymeric housing shall protect from the effect of weather, withstands an environmental conditions without failure (pollution, UV, rain, heat etc.) and avoids flash over for wet and dry AC conditions as well as the residual voltage during surge discharge.
(b) The polymeric housing also thermally cycles with the ZnO discs to maintain a moisture seal without loss of performance.
(c) The Arrester housing shall confirm to the requirement of IEC specification.

7.3: Insulating base & discharge counter shall be provided for the 220KV arrestors. The discharge counter shall be provided with milli-ammeter for measuring the leakage current and shall not require any DC or AC Aux. supply. It shall be suitable for outdoor use.

The installation of discharge counter shall not adversely affect the Arrester performance.

7.4: The discharge counter shall register operation whenever surge or any other type of surge strikes the Surge Arrester.

7.5: All necessary accessories and earthing connection leads between the bottom of the Arrester and the discharge counter shall be in the Bidder’s scope of supply. The connecting lead between discharge counter and Surge Arrester shall be of copper strip of size 25 x 4 mm and minimum of 1.5 meter length. The discharge counter shall be so designed that the readings of discharges recorded by the counter and the readings of milli-ammeter shall be clearly visible through an inspection window to a person standing on ground.

7.6: Terminal Connectors conforming to IS:5561 shall be supplied alongwith the arresters.

7.7: The grading ring on each complete arrester for proper stress distribution shall be provided if required for attaining all the relevant technical parameters.

7.8: Each surge counter shall have terminals of robust construction for connection to earthing lead and these shall be suitably arranged so as to enable the incoming and outgoing connections to be made with minimum bands.

7.9: The grounding terminals shall be suitable for accommodating grounding connection to steel earthing mat. Proper functioning of the surge counter with surge Arrester shall be ensured by the supplier.

8.0 MOUNTING:

The arresters shall be suitable for mounting on steel structures. The necessary flanges, bolts etc. for mounting the base are within the scope of supply.

9.0 TERMINAL CONNECTORS:

The surge arresters shall be provided with appropriate number of solderless clamp type connectors suitable for Single AL-59 (Moose equivalent) conductor for 198KV (heavy duty) station class Surge Arresters. Each Terminal Clamp shall be suitable for both vertical and horizontal connections of the line conductor. Each Terminal Connector shall further be provided with appropriate number of grounding terminals and the clamps for receiving ground connections.
10.0 PRESSURE RELIEF DEVICE:

The surge arresters shall be fitted with efficient pressure relief device so as to check explosive shattering of the housing following prolonged passage of systems short circuit current. The pressure relief device shall be suitable for high current pressure relief test on minimum prospective symmetrical fault current as 40KA (rms) and low current pressure relief test as per IEC-99-4 (latest amended). The bidder/supplier shall provide the type test certificates in respect of pressure relief test alongwith certified drawing so as to establish that the pressure relief device so offered with the equipment is the same as was tested at that independent Testing Laboratory.

11.0 TESTS:

11.1 “TYPE TESTS”

(a) The test reports for the following tests as per ISS/IEC, conducted in a Govt./ Govt. approved/ Govt. recognized/ NABL accredited test lab shall be furnished by the bidder/ supplier. These test reports should not be older than 7 years as on the date of opening of technical bid for which the date of conducting the test shall be considered:

(i) Insulation withstand test certifying value of basic insulation level.
(ii) Residual voltage test.
(iii) Long duration current impulse with stand test.
(iv) Operating duty test.
(v) Bending moment test report on complete arrester unit, if the facility is available at CPRI & if not, the test can be witnessed by CPRI in the manufacturer’s premises and report can be accepted.

(b) Type test report for short circuit test shall be furnished as per IEC 60099-4 Edition 1.2-2001 or latest amended IEC.

(c) Artificial Pollution test on porcelain housed multunit surge arrester shall be accepted as per ANSI standard (American standard) IEEE-C-62.11-1999 as the facilities for conducting the same as per IEC are not available with CPRI.

(d) For polymeric arresters, in addition to above, following tests reports are to be furnished:

(i) Moisture Ingress Test.
(ii) Weather ageing Test.

11.2 ROUTINE TESTS:

The each unit of surge arresters and accessories shall be subjected at manufacturer’s works for the following tests as per ISS before offer of material for inspection:

(i) Measurement of reference voltage.
(ii) Residual voltage test.
(iii) Internal Partial discharge test.
(iv) For arrester units with sealed housing, a leakage check shall be made on each unit as hereunder:

Units of 198 KV Arrester >= 10 Gega ohm.

11.3 ACCEPTANCE TESTS:

The following tests shall be got conducted in presence of purchaser’s representative, as per stipulation of the relevant ISS. Acceptance tests wherever possible, shall be conducted on the complete arrester unit. Number of samples to be selected for acceptance tests shall be nearest lower whole number to the cube root of the number of arresters offered for inspection.
(i) Measurement of power frequency reference voltage on the complete arrester at the reference current measured at the bottom of the arrester.
(ii) Lightning impulse residual voltage.
(iii) Internal Partial discharge test.
(iv) Visual inspection & verification of dimension.

11.4 TEST ON BOUGHT OUT ITEMS:

The manufacturer’s test report shall be accepted for the following tests at the time of inspection:

(i) Temperature cycle test on arrester housing.
(ii) Porosity test on porcelain housing.
(iii) Galvanizing test.
(iv) Test for Terminal Connector.

11.5 TOLERANCE ON TEST RESULTS: As per relevant standards/ specification.

12.0 MATERIAL AND WORKMANSHIP:

All the materials used in the manufacturing of equipment shall be of best quality of their respective kind and the whole of the work shall be of the highest class well finished off, approved design and make. Castings shall be free from blow holes, flaws, cracks and other defects and shall be smooth class grain and of the true form and dimensions. All machined surfaces shall be true and smooth finished. The finish of the end caps should be such that the verticality of surge arresters is obtained satisfactorily. The arrester shall be completely assembled at the works to ascertain that all parts fit correctly and surge arrester is erected vertically.

13.0 INSTRUCTION PLATE AND MARKING:

The arrester shall be provided with non-corrosive legible name plate indelibly marked with the following information:

1. Rajasthan Solar Park Development Company Ltd.
2. Order No.
3. Manufacturer’s name or trade mark and identification No. of the arrester being supplied.
4. Rated voltage.
5. Maximum continuous operating voltage.
6. Type.
7. Rated Frequency.
8. Nominal discharge current.
9. Long duration discharge class.
10. Pressure relief current in KA rms.
11. Year of manufacture.

14.0 GUARANTEE PERIOD:

The guarantee period of each LA shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION OF 30KV (HEAVY DUTY) STATION CLASS SURGE ARRESTER (LIGHTNING ARRESTERS)

1.0 SCOPE:

This specification covers design, manufacturing, assembly testing at manufacturer’s works of 30 KV (HEAVY DUTY) station class metal oxide Surge Arresters. The Surge Arresters shall be complete in all respects conforming to modern design and practice for protection of transformers and other substation equipments of 3 phase, 50Hz & solidly grounded neutral AC system. The surge arresters are required for 33 KV system protection. The arrester housing shall be porcelain/polymer as per IEC standard.

2.0 STANDARDS: This shall be as per Clause No. 2.0 of 198KV Surge Arresters dealt above.

3.0 PARTICULARS OF THE SYSTEM:

The arresters shall be used on 3 phase, 50 cycles effectively grounded neutral AC system. The maximum system voltage for 33 KV system shall be 36 KV (rms). The system frequency may vary by +3% from normal of 50 Hz.

4.0 IMPULSE WITHSTAND VOLTAGE OF EQUIPMENT AND TRANSMISSION LINES:

The basic insulation level of Transformers, Circuit Breakers and other equipments like instrument transformers and transmission lines for 33 KV system shall be 170 Kvp.

5.0 TYPE AND RATING OF SURGE ARRESTERS:

The surge arresters should be of single pole having multi-units of outdoor self supporting type, heavy duty station class for 33 KV system. The lightning arrester (LA) shall have nominal discharge current of 10KA. The voltage rating for 33 KV system shall be 30kV (rms).

6.0 CHARACTERISTICS:

The lightning arresters shall generally conform to IEC-99-4 (latest addition). The Surge arrester shall be suitable for system parameters (equipment/ lines) as mentioned in specification and shall be capable of repeated successive operations for discharging the transmission lines while conducting for limiting switching surge and shall be capable of satisfactory operation within stipulated limits against lightning and switching surges.

The guaranteed duration for which the arresters can be temporarily subjected to atleast 10% power frequency over voltage without affecting their operating properties shall be clearly stated.

The design features, type test certificates and other documentary evidence in support of above features of the arresters shall be furnished. The power frequency over voltage and its duration to which the arrester offered can be subjected without affecting any of its operating properties shall be explicitly guaranteed by the tenderer/supplier.

The equipment offered under this specification for gapless metal oxide type station class LAs shall be suitable for the parameters as mentioned below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARAMETERS</th>
<th>33KV SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Rated voltage KV (rms)</td>
<td>30</td>
</tr>
<tr>
<td>2)</td>
<td>Nominal system voltage KV (rms)</td>
<td>33</td>
</tr>
<tr>
<td>3)</td>
<td>Max. system voltage KV(rms)</td>
<td>36</td>
</tr>
<tr>
<td>4)</td>
<td>Max. continuous operating voltage (MCOV) not less than KV(rms)</td>
<td>25</td>
</tr>
<tr>
<td>Nominal discharge current (KA)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Long duration discharge class</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Type of construction for 10KA rated arrester</td>
<td>Single col. Single phase</td>
<td></td>
</tr>
<tr>
<td>Min. energy discharge Capability (KJ/KV).</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Safe fault current (KA)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Lightning impulse withstand voltage with 1.2/50 micro sec. wave (KVp).</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>One minute power frequency withstand voltage of housing (dry/weight)- KV (rms).</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>High current short duration impulse withstand level with 4/10 microsecond wave KA (peak)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Minimum pressure relief current (KA rms)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Terminal Connector suitable for conductor of size</td>
<td>Single Tarantulla</td>
<td></td>
</tr>
<tr>
<td>Take off (both Vertical &amp; Horizontal)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Voltage (Corona extinction) (KV rms)</td>
<td>Rated Voltage</td>
<td></td>
</tr>
<tr>
<td>Whether insulating base and discharge counter with mili-ammeter are required</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Min. creepage distance of Arrestor housing (mm)</td>
<td>900</td>
<td></td>
</tr>
</tbody>
</table>

### 7.0 ACCESSORIES AND FITTINGS:

#### 7.1 PORCELAIN HOUSING:

- All porcelain housings shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths.
- The porcelain shall be well vitrified and non porous.
- The creepage distance of the Arrestor housing shall be as mentioned above.
- The porcelain petticoat shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc., shall be indicated by the Bidder.
- The Arrestor housing shall conform to the requirements of IEC specification.

#### 7.2 POLYMERIC HOUSING:

- The silicon polymeric housing shall protect from the effect of weather, withstands an environmental conditions without failure (pollution, UV, rain, heat etc.) and avoids flash over for wet and dry AC conditions as well as the residual voltage during surge discharge.
- The polymeric housing also thermally cycles with the ZnO discs to maintain a moisture seal without loss of performance.
- The Arrestor housing shall confirm to the requirement of IEC specification.

#### 7.3:

All necessary accessories and earthing connection leads between the bottom of the Arrestor and the discharge counter shall be in the Bidder’s scope of supply. The connecting lead between discharge counter and Surge Arrestor shall be of copper strip of size 25 x 4 mm and minimum of 1.5 meter length.

#### 7.4:

Terminal Connector conforming to IS:5561 shall be supplied alongwith the arrester.

### 8.0 MOUNTING:

The arrester shall be suitable for mounting on steel structures/Beam. The necessary flanges, bolts etc. for mounting the base are within the scope of supply.

### 9.0 TERMINAL CONNECTORS:

The lightning arresters shall be provided with appropriate number of solderless clamp type Connectors suitable for Single Tarantulla conductor for 30 KV (heavy duty) station class lightning.
arrester. Each terminal clamp shall be suitable for both vertical and horizontal connection of the bay conductor. Each Terminal Connector shall further be provided with appropriate number of grounding terminals and the clamps for receiving ground connections.

10.0 PRESSURE RELIEF DEVICE:

The lightning arrester shall be fitted with efficient pressure relief device so as to check explosive shattering of the housing following prolonged passage of system short circuit current. The pressure relief device shall be suitable for high current pressure relief test on minimum prospective symmetrical fault current as 40KA (rms) and low current pressure relief test as per IEC-99-4 (latest amended). The tenderer/supplier shall provide the type test certificates in respect of pressure relief test along with certified drawing so as to establish that the pressure relief device so offered with the equipment is the same as was tested at that independent Testing Laboratory.

11.0 TESTS:

11.1 TYPE TESTS:

(a) The test report for the following tests as per ISS/IEC, conducted in a Govt./Govt. approved/ Govt. recognized / NABL accredited test lab shall be furnished by the bidder/supplier. These test reports should not be older than 7 years as on the date of opening of technical bid for which the date of conducting the test shall be considered:

(i) Insulation with stand test certifying value of basic insulation level.
(ii) Residual voltage test.
(iii) Long duration current impulse with stand test.
(iv) Operating duty test.
(v) Bending moment test on complete arrester unit reports if the facility is available at CPRI and if not the test can be witnessed by CPRI in the manufacturer’s premises and report can be accepted.

(b) Type test report for short circuit test shall be furnished as per IEC 60099-4 Edition 1.2-2001 or latest amended IEC.

(c) Artificial Pollution test on porcelain housed multiunit surge arrester shall be accepted as per ANSI standard (American standard) IEEE-C-62-1999 as the facilities for conducting the same as per IEC are not available with CPRI.

(d) For Polymeric Arrester in addition to above following test are to be furnished:

(i) Moisture ingress test.
(ii) Weather ageing test.

11.2 ROUTINE TEST:

The each unit of surge arrester and accessories shall be subjected at manufacturer’s works for the following tests as per ISS before offer of material for inspection:

(i) Measurement of reference voltage.
(ii) Residual voltage test
(iii) Internal Partial discharge test
(iv) For arrester units with sealed housing a leakage check shall be made on each unit as hereunder:

1500mm water dip for 30 minutes followed by megger test with 5 KV megger 30 KV > = 1 Gega ohm.

11.3 ACCEPTANCE TEST:

The following tests shall be got conducted in presence of purchaser’s representative as per stipulation of the relevant ISS. Acceptance tests wherever possible, shall be conducted on the
complete arrester unit. Number of samples to be selected for acceptance tests shall be nearest lower whole number to the cube root of the number of arresters offered for inspection.

(i) Measurement of power frequency reference voltage on the complete arrester at the reference current measured at the bottom of the arrester.
(ii) Lightning impulse residual voltage.
(iii) Internal Partial discharge test.
(iv) Visual inspection & verification of dimension.

11.4 TEST ON BOUGHT OUT ITEMS:

The manufacturer’s test report shall be accepted for the following tests at the time of inspection:

(i) Temperature cycle test on arrester housing.
(ii) Porosity test on porcelain housing
(iii) Galvanizing test.
(iv) Test for terminal clamp.

11.5 TOLERANCE ON TEST RESULTS: As per relevant standards/ specification.

12.0 MATERIAL AND WORKMANSHIP:

All the materials used in the manufacture of equipment shall be of best quality of their respective kind and the whole of the work shall be of the highest class well finished off approved design and make. Castings shall be free from blow holes, flaws, cracks and other defects and shall be smooth class grain and of the true form and dimensions. All machined surfaces shall be true and smooth finished. The finish of the end caps should be such that the verticality of lightning arresters is obtained satisfactorily. The arrester shall be completely assembled at the works to ascertain that all parts fit correctly and lightning arrester is erected vertically.

13.0 INSTRUCTION PLATE AND MARKING:

The arrester shall be provided with non-corrosive legible name plate indelibly, marked with the following information:

1. Rajasthan Solar Park Development Company Ltd.
2. Order No.
3. Manufacturer’s name or trade mark and identification No. of the arrester being supplied.
4. Rated voltage.
5. Maximum continuous operating voltage.
6. Type.
7. Rated Frequency.
8. Nominal discharge current.
9. Long duration discharge class.
10. Pressure relief current in KA rms.
11. Year of manufacture.

14.0 GUARANTEE PERIOD:

The guarantee period of each LA shall be 12 Months from the date of commissioning or 18 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION OF 800A L.T. SWITCHGEAR PANEL

1.0 SCOPE:

This specification covers the design, manufacture/ fabrication, testing before dispatch of low tension switchgear panel suitable for indoor installation. The switch boards shall be complete in every respect for the functions designated.

1.1 STANDARDS:

The rating as well as performance and testing of the equipments and their accessories and fittings shall conform to the latest revisions and amendments of the following standards:

(i) Factory build assemblies of switchgear & control gear : IS-8623
(iv) Fuse : IS-13703 (part-1)
(v) Current Transformer. : IS-2705.
(vi) Indicating Instruments. : IS-1248.
(vii) Integrating Instruments : IS-13779

1.2 GENERAL REQUIREMENT:

The switch boards are to be complete in every respect for the functions designated. The 800A L.T. switchgear panels shall be equipped with the equipments specified here under:

Schedule of equipment for 800 amp low tension switchgear panel:

(A) The LT switchgear panel shall be equipped as under:

(1) Incoming circuit consisting of the following:

(i) One ACB, Withdrawable type, triple pole, 800 Amp. with interlocking arrangement, suitable for 415 Volts AC, 50 cycle having a rupturing capacity of 25 MVA at 415 volts with spring charged closing mechanism.

Facility shall be provided for charging the spring with motor (240 V AC, 50Hz) as well as with manual spring charging handle, which shall be supplied with the ACB.

The ACB shall have the provision for closing & tripping manually using push buttons and also electrically using T-N-C switch.

(ii) Mechanical ON/OFF indicators.
(iii) One Shunt trip coil 220 V DC.
(iv) One closing coil 220 V DC.
(v) One Trip-Neutral-Close (T-N-C) control switch.
(vi) One motor operated spring charging mechanism suitable for 220V AC, 50Hz. Facility of manual spring charging shall also be provided.
(vii) One 8 way Auxiliary switch with 4NO and 4NC contacts.
(viii) One red lamp for ON indication.
(ix) One green lamp for OFF indication.
(x) One white lamp for tripped indication.
(xi) One Amber lamp for trip circuit healthy check alongwith push button.

(2) Bus Bars consisting of the following:
(i) One set of 3 phase 800 Amp. rating insulated Copper bus bars.
(ii) One Neutral 400 Amp. rating insulated Copper bus bars.
(iii) One bolted type neutral link.

(3) Three ring type double core Current Transformers having 800/5-5 Amp. ratio for protection & metering. Alternatively, six single core CTs, three for metering and three for protection may also be acceptable. Class of accuracy for protection shall be 5P 10 and for metering 0.5.

(4) One triple pole IDMT (2 x Over Current +1 x earth fault) self powered relay, each O/C & E/F unit with HS element. Relay shall be drawout type. If not, separate test terminal block shall be provided for testing the relay without taking it out of service. Static/ Numerical earth fault and over current relays shall also be acceptable.

(5) One 3 phase 4 wire CT operated Static KWH meter of class 1.0 accuracy suitable for unbalanced load (Flush mounting type) with test terminal block.

(6) One 144 mm square flush mounting MISC Ammeter scaled 0-400A/800 Amps, accuracy class 1.0.

(7) One ammeter selector switch.

(8) One 144 mm square flush mounting MISC voltmeter scale 0-500 Volts, accuracy class 1.0.

(9) One voltmeter selector switch. (6 position).

(10) One No-Volt relay (415 V AC) connected to the bus-bar (Fixed setting between 70-80% of rated AC voltage)

(11) Annunciation scheme for audio-visual alarm of AC supply failure alongwith push button for accepting the audio signal & failure indication lamp with blue lens, suitable for 220 V DC.

(12) One set of cable glands with cable lugs suitable for the reception of 2 Nos. of 3.5 core, 300 sq. mm aluminium conductor PVC cables & 2 Nos. of 2 Core, 2.5 Sq.mm Copper conductor PVC cables.

(B) Outgoing circuits of 800 Amps LT panel shall consist of fuse switch with HRC fuses as under:

(i) One incomer and two outgoing triple pole quick make quick break double break per phase pull out type fuse switch units 200 Amps. with neutral link and with HRC fuses of 200 Amps with cable glands suitable for 2x3.5 core 185 Sq.mm aluminium conductor PVC cable with a set of cable lugs.

(ii) The outgoing supply from this fuse switch unit shall be connected through CT of ratio 200/5A & accuracy class 0.5 to a 3 phase 4 wire CT operated static KWH meter of class 1.0 accuracy through test terminal block.

LABELS:

(a) 220 KV CIRCUIT BREAKERS.
(b) 33 KV CIRCUIT BREAKERS.
(c) TRANSFORMERS (220/33 KV)
(d) BATTERY CHARGER 220 V.
(e) BATTERY CHARGER 48 V.
(iii) 5 Nos. triple pole quick make quick break double break per phase switch fuse units/switch dis-connector 32 Amps. with neutral link and with HRC fuses 32 Amps. with 10 Nos. cable glands suitable for 4 core 6 sq.mm copper conductor PVC cable and 40 Nos. of cable lugs.

LABELS:

(a) YARD LIGHTING.
(b) CONTROL ROOM LIGHTING.
(c) TUBE WELL.
(d) SPARE.
(e) SPARE.

(iv) 2 Nos. single phase two pole quick make quick break double break per phase switch fuse units/switch dis-connector 32 A with neutral link and with HRC fuses 32 Amps. with 6 Nos. cable glands suitable for 2 Core 2.5 sq.mm copper conductor PVC cable and 12 Nos. of copper lugs.

LABELS:

(a) CONTROL & RELAY PANELS
(b) DC & RTCC PANELS.

1.3 PANELS:

The approximate over all dimensions of the panels shall be as under:

(a) Height. : 2312 mm with base channel of 102 mm
(b) Depth. : 700 mm
(c) Width. : 1600 mm

The panels shall be fabricated out of CRCA sheet steel and shall be assembled together to form a continuous switch board. The panels shall be dust and vermin proof and protected from the ingress of moisture. All openings and outlets in the door shall be machine made and shall be free from burrs, weld runs be ground smooth. All sheet surfaces shall be free from dents and hammer marks. The front panel, base frame and door frame shall be manufactured from CRCA sheet steel 10 SWG (3mm) thick, while the side panels roof and doors shall be manufactured out of 14 SWG (2mm) thick CRCA sheet steel. The enclosure shall provide a minimum degree of protection equivalent to IP-51 in accordance to IS: 13947.

1.4 PAINTING:

(i) All sheet steel work shall be phosphated in accordance with IS:6005 code for practice for phosphating iron and steel.
(ii) Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
(iii) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with slightly alkaline hot water and drying.
(iv) After phosphating thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
(v) The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be “flash dried” while second coat shall be stoved.
(vi) After application of primer two coats of finishing synthetic enamel paint shall be applied, each coat shall be applied followed by stoving the second coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be as per shade 631 of IS-5. The interior of the panel shall be of white colour and the base frame shall be painted black.
(vii) Each of coat of primer and finished paint shall be of slightly different shade to enable inspection of painting.

1.5 AIR CIRCUIT BREAKER:

The air circuit breaker of suitable rating shall be of horizontal triple pole totally enclosed fully interlocked pattern, independent manual spring operated type, pad locking arrangement shall be provided on the breaker to lock it in its OFF position. It should be suitable for 500 Volts, 3 phase AC 50 Hz system and shall have rupturing capacity as per the schedule of equipment. The ACB shall be withdrawable type. The spring charging arrangement shall be motor operated, however, additional manual spring charging arrangement shall also be provided.

The circuit breaker shall be capable to protect the system against short circuit, over current & earth fault through inverse over current and earth fault relays. Provision for manual closing & tripping by hand should also be provided. Facility to close and trip the breaker electrically through T-N-C switch shall also be provided. The breaker should be of trip free mechanism type. Mechanical ON/OFF indicator shall also be provided for indicating the position of the breaker.

All current carrying copper contacts on the breaker shall be silver plated. The circuit breakers shall fully comply with the requirement of IS: 13947 part-(2) with latest amendment thereof and shall be suitable for continuous operation under the climatic conditions specified.

1.6 BUS BARS:

The bus bars will be of vertical copper strip, the phases being in horizontal configuration and shall be suitable for carrying the rated current continuously under the climatic conditions specified. The Bus Bar shall be provided in Top chamber horizontally and a clearance of 75mm is to be provided on both sides of the bus bar. Facility for extending the Bus bars and connecting to adjacent panels shall be provided on both sides. The openings on the side of the panels shall be closed with gasketted blanking plates. The bus bar chamber shall be designed to allow easy interchangeability of fuse switch units. Provisions shall be made for future extensions of panels on both sides. All bus bars shall be of solid construction and shall be insulated with PVC sleeving/taping. The bus bars shall be supported by non hygroscopic insulation material with high dielectric and mechanical strength and shall be supported rigidly. The bus bar coupling clamps used for connecting up the bus bar of the adjacent sections of bus may be of bolted type.

1.7 FUSE COMBINATION UNIT:

Fuse combination unit shall correspond to the requirements of latest edition of IS:13947 (part-3) and its associated specification. The rating of the composite fuse switch unit and the associated fuses of g-II duty conforming to IS:13703 Part-I are given in the schedule of equipments. ‘ON’ ‘OFF’ position of the switch shall have a definite indication, the design being such as to guard against false indication. Interlocks shall be provided in the fuse switch unit as per IS:13947. Switches shall be of quick make and quick break double break design. All switches shall break the circuit positively even if the mechanism springs fail. The switches shall be operated by a suitable external handle complete with position indicator. It shall not be necessary to pull out or insert the operating handle of the switches. The handle shall be a normal & permanent feature of the equipment. Switch contacts shall be of tinned copper or silver alloy/silver plated and contact springs shall be of stainless steel. The switches shall be capable of withstanding the through fault current of the backup fuse.

Where ever possible, flared arcing tips shall be provided on moving contact fingers. Positive and complete phase separation shall be ensured by providing phase separators (throughout) the travel of the moving contacts mounting arrangement for all composite fuse switch units shall be designed to facilitate easy replacement during maintenance.
1.8  FUSE:

Each composite fuse switch unit shall be fitted with high rupturing capacity fuses fully complying with latest edition of IS:13703 (part-1) and be of pull out and bolted type and of g-II type. Provision shall be made to lock the 'ON/OFF' position of the switch and shall have a definite indication in such a design to guard against false indication. Interlocks shall be provided in the fuse combination unit.

1.9  TERMINALS:

All the terminals shall be provided with adequate electrical contacts for appropriate size of aluminium/copper conductor and bimetallic washers if necessary for aluminium cables.

1.10  CABLE ENTERIES:

The cable entries for the circuit breaker and fuse combination unit shall be through cable glands, the number and sizes of cable glands have been indicated in the schedule of equipments. All the cable glands shall be suitable for PVC cable.

Bottom plate of 4 mm thickness shall be provided for making the base dust tight. Cable gland plates of 4 mm thickness shall be provided on this bottom plate and fitted with the specified number of cable glands.

1.11  LIMITS OF TEMPERATURE RISE:

The maximum temperature rise for various parts under the rated conditions specified in the specification shall not exceed the limits of temperature specified in the relevant ISS/BSS/IEC.

1.12  CURRENT TRANSFORMERS:

The Current Transformers shall be of double core ring type and comply with the requirements of IS:2705. The accuracy class of CT shall be of 0.5 for metering and 5P10 for protection. The rated burden of the CT shall be 15VA for each core. The insulation level shall not be less than the value indicated for the Circuit Breaker. Alternatively, two single core CTs, one for metering and other for protection may also be acceptable.

1.13  WIRING:

L.T. Panel shall be completely factory wired ready for connections to the incoming/outgoing cables. All central wiring shall neatly run and be properly supported. The terminals shall be of adequate current rating and size to suit individual feeder requirements. The colour code of the wiring shall be as per the latest edition of IS:11353.

1.14 (A)  INDICATING INSTRUMENTS:

The indicating instruments shall be of reputed make and accuracy class of 1. The arrangement of the instrument shall be logical. The instruments shall be flush mounted and shall comply with the latest edition of IS:1248.

1.14 (B)  INTEGRATING INSTRUMENTS:

The integrating instruments shall be Static of reputed make and accuracy class of 1.0. The instruments shall be flush mounted and shall comply with the latest conditions of IS 13779.

1.15  MAKES OF BOUGHT OUT ITEMS:
(i) Air circuit breaker           - Schneider-CG/Control & Switch gear/ABB/Alstom/GE/L&T/Spaecage
(ii) Fuse combination unit   - GE/Schneider-CG/Control and Switchgear.
(iii) CT (0.5 class)                 - Continental/Mehru/Perfect.
(iv) Relay                        - JVS/ABB/Alstom/SIEMENS/ER
(v) Indicating instruments       - AE/IMP/MECO
(vi) Integrating instruments     - SEMS/L&T/ABB
(vii) Indicating lamps/LEDs       - Alstom/Teknic/Vaishno/Deepal/JVS/EASUN/Connect well
(viii) Annunciator scheme        - Pradeep/JVS/Minilac/Instalarm/ ALAN
(ix) Selector switch              - Switron/Kayee/Recom
(x) Control Switch                - Alstom/Recom/Switron/Kayee
(xi) Hooter                       - JVS/Alan/Target/Industrial Hooter.
(xii) Fuse HRC g-II               - GE/Havells/C&S.

1.16 LABELS:
Engraved labels shall be provided on all the incoming and outgoing compartments.

1.17 INSPECTION AND TESTING:
The following tests shall be got conducted in presence of RSDCL's representative:

(i) Routine tests as per IS-8623 shall be carried out in the presence of RSDCL's representative.
(ii) The panels should also be physically examined for dimensional check up, sheet thickness & Bill of material as specified.
(iii) Operational test for Air Circuit Breaker and Relay.
(iv) Firm shall also submit manufacturer’s test certificates for ACB, KWH meter, CT, Relay, Ammeter etc. to be supplied with the panel.

1.18 TYPE TESTS:
All the equipments offered shall be fully type tested as per the relevant standards. The test reports for the following tests, conducted in a Govt./ Govt. approved/ Govt. recognized/ NABL accredited test lab shall be furnished by the bidder/supplier. These test reports should not be older than 7 years as on the date of opening of technical bid for which the date of conducting the test shall be considered:

(a) Temperature rise test.
(b) Short Circuit test on bus bar fitted in the panel.
(c) Degree of enclosure protection equivalent to IP-51 in accordance with IS 13947(Part-1) on any panel manufactured.

1.19 GUARANTEE PERIOD:
The guarantee period of each L.T. Panel (including all Relays & accessories) shall be 30 Months from the date of commissioning or 36 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 220V DC CONTROL AND DISTRIBUTION BOARDS

1.0 SCOPE:

This specification covers the design, manufacture, assembly, testing at manufacturer’s works before dispatch of 220V DC Control and distribution boards.

2.0 GENERAL REQUIREMENTS:

The intention of the specification is to provide DC Control and distribution Boards as enumerated in the specification and to be fully complete in every respect for the functions designated. The equipment shall cover all apparatus, appliances and material whether specifically mentioned or not but which may be found necessary to complete or test DC control and distribution board in compliance with the requirements of the specification. The DC control and distribution boards shall generally comply to the requirements of IS:8623 “Specifications for factory built assemblies of switchgear & control gear for voltages upto & including 1000V AC & 1200 V DC”.

3.0 STANDARDS:

Equipment shall conform to the latest revisions and amendments of the following standards:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>STANDARD NO.</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS:3231</td>
<td>Protective Relays.</td>
</tr>
<tr>
<td>2.</td>
<td>IS:8686</td>
<td>Static Protective Relays.</td>
</tr>
<tr>
<td>3.</td>
<td>IS:1248</td>
<td>General requirement of indicating &amp; integrating meters.</td>
</tr>
<tr>
<td>6.</td>
<td>IS:5</td>
<td>Colour for ready mix paints and enamels.</td>
</tr>
</tbody>
</table>

4.0 EQUIPMENTS DETAILS:

4.1 The DC Distribution Board shall be suitable for receiving the DC supply from the battery charger and for the distribution of same for the control & indicating, annunciation & lighting circuits etc., as given here under.

BILL OF MATERIAL AND LIST OF EQUIPMENTS TO BE MOUNTED ON 220V DC CONTROL AND DISTRIBUTION BOARD:

This shall be equipped as under but not limited to the equipment listed as below:

(A) Double pole moulded case air circuit breaker quick action load break type rated for 25 Amps. and labeled as under:

<table>
<thead>
<tr>
<th>Description</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>220 KV C&amp;R PANELS</td>
<td>J1, J2</td>
</tr>
<tr>
<td>132 KV C&amp;R PANELS</td>
<td>J5, J6</td>
</tr>
<tr>
<td>33 KV C&amp;R PANELS</td>
<td>J11, J12</td>
</tr>
<tr>
<td>ANNUNCIATION, 220 KV SIDE</td>
<td>J15, J16</td>
</tr>
<tr>
<td>ANNUNCIATION, 132 KV SIDE</td>
<td>J21, J22</td>
</tr>
<tr>
<td>ANNUNCIATION, 33 KV SIDE</td>
<td>J25, J26</td>
</tr>
<tr>
<td>LT &amp; RTCC PANELS</td>
<td>J31, J32</td>
</tr>
<tr>
<td>PLCC/SLDC</td>
<td>J35, J36</td>
</tr>
<tr>
<td>EMERGENCY LIGHT</td>
<td>J41, J42</td>
</tr>
<tr>
<td>BUS BAR AND LBB PRONT</td>
<td>P1, P2</td>
</tr>
<tr>
<td>SPARE</td>
<td>J45, J46</td>
</tr>
</tbody>
</table>
(B) Double pole AC Power contactor for control room emergency lighting (230V AC) : 1 No.

(C) Indicating lamps/LED'S (Group of four) MCCB ON (RED) & OFF (GREEN) indication. : 22 Nos.

(D) Moving coil ammeter for load current, class-I accuracy 0-20 Amps. (size 144 x 144mm) with external shunt. : 1 No.

(E) Moving coil DC voltmeter, class -I accuracy, 0-300 V (size 144 x 144 mm). : 1 No.

(F) Selector Switch for the voltmeter (4 positions) : 1 No.

(G) DC under voltage relay with alarm contacts. : 1 No.

(H) DC earth fault relay with alarm contacts. : 1 No.

(I) AC No volt relay with alarm contacts. : 1 No.

(J) Annunciation scheme operating on 220V DC supply for audio visual alarm of the following alongwith accept, rest & test push buttons with facia inscription as below:

   (a) DC earth fault.
   (b) AC supply fail.
   (c) MCCB Trip (common for 11 MCCB's).

(K) Annunciation scheme operating on 230V AC supply for audio visual alarm of the following alongwith accept, rest & test push buttons with facia inscription as below:

   "DC under voltage".

NOTE: Please refer to Clause 4.2.5 for requirements of functioning of annunciation scheme.

4.2 MOULDED CASE CIRCUIT BREAKERS:

4.2.1: The above circuits shall be controlled by air circuit breaker of moulded case type fitted with releases of 16A current rating having thermal over load and instantaneous high current short circuit tripping devices and shall be suitably rated to carry the DC current continuously without undue heating. The making and the breaking capacity ratings shall be properly co-ordinated with the current to be broken in the circuit but it shall not be less than 3KA. The MCCB'S shall be provided with necessary auxiliary contacts for alarm and position indication of MCCB. Common alarm annunciation scheme (audio-visual) shall also be included for all MCCB'S.

4.2.2: The MCCB'S offered shall conform to the requirements of latest issue of relevant Indian Standard and shall be suitable for operation in the climatic conditions specified in this specification. MCCB shall be supplied complete in all respect including all standard accessories used for their satisfactory operation and as detailed in the specification.

4.2.3: The MCCB's shall have dust tight cases. They shall preferably be suitable for flush mounting and shall be free from errors due to change in ambient temperature and shall be able to withstand maximum possible electrical/mechanical stress likely to be encountered in service. The insulating case of the MCCB shall be made of high strength, heat resistant and flame retardant thermosetting insulating material. The MCCB shall be trip free.

4.2.4: The DC connection from the above circuit breakers shall be brought to the terminals inside the distribution board from where the distribution of DC voltage can be affected to the required terminals. The DC outgoing circuits other than those controlled by MCCB'S shall
be properly fused. All terminals shall be clearly marked and their particulars shall be inscribed on the terminals.

4.2.5 ALARM ANNUNCIATION SCHEME:

The MCCBs shall be provided with necessary auxiliary contacts for alarm and position indication of MCCBs Alarm annunciation schemes (audio-visual) shall also be included which shall function as below:

<table>
<thead>
<tr>
<th>Fault Condition</th>
<th>Manual Action</th>
<th>Operating Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Audio</td>
<td>Visual</td>
</tr>
<tr>
<td>Normal</td>
<td>-</td>
<td>OFF</td>
</tr>
<tr>
<td>IC CLOSED</td>
<td>-</td>
<td>ON</td>
</tr>
<tr>
<td>IC CLOSED</td>
<td>ACCEPT</td>
<td>OFF</td>
</tr>
<tr>
<td>IC CLOSED</td>
<td>RESET</td>
<td>OFF</td>
</tr>
<tr>
<td>IC OPEN</td>
<td>RESET</td>
<td>OFF</td>
</tr>
</tbody>
</table>

IC = Initiating Contact

4.3 CHANGE-OVER CONTACTORS:

4.3.1: Automatic change over power contactors of appropriate rating shall be incorporated in the control board to change the AC circuit to DC circuit automatically in case of failure of 230 Volts AC supply for control room/ Switchyard lighting and back to AC circuit after restoration of AC supply. Provision shall be made to avoid intermingling of AC/DC during changeover since the changeover shall be on same wiring. The AC No Volt relay shall have operating range of 80-115% of rated voltage. Spare contact for audio visual alarm shall be available.

4.3.2: The contactors shall also have dust tight cases, shall be free from errors due to change in ambient Temp. and shall be able to withstand max. possible electrical and mechanical stress encountered in service. The contactors shall conform to the requirements of latest issue of relevant Indian standards.

4.3.3: Necessary auxiliary contacts shall be provided for safety inter locking.

4.4 GENERAL RELAYING REQUIREMENTS:

4.4.1: Under Voltage relays and the earth fault relays are to be provided to initiate an alarm for low voltages and the earth fault in the DC system.

4.4.2: The DC earth fault relay and no volt relay offered by the supplier shall comply with the requirement of latest issue of ISS:3231 or relevant IEC and shall be suitable for operation in the climatic conditions specified in specification.

4.4.3: Each relay shall be provided with dust tight, removable glass covers with glass windows. The relay shall be so arranged that on opening the case, it shall be impossible for any dust which may have collected in or upon the case, to fall on the relay mechanism. The operation of the relays shall be practically free from errors due to normal variation in frequency and wave form (for AC relay) and from ambient temperature effects specified in clause climatic conditions of the specification.

4.4.4: The relay coils shall be able to withstand the maximum possible thermal and mechanical stresses likely to be encountered in service, without damaging the coil and mechanical
parts. Each relay coil shall be vacuum impregnated with an insulating compound and shall be heat and moisture resistant.

4.4.5: The Terminal blocks for incoming DC supply from the battery charger shall be suitable for 25 Sq.mm. Copper conductor. The terminal blocks for outgoing circuits shall be suitable for 10 Sq.mm Copper conductor. These shall have bases and barriers moulded integrally with brass inserts and shall be suitable for 660 Volts service. The terminals shall be stud type and shall be provided with plain washer, spring washer and nut for all incoming and outgoing circuits.

4.4.6: The fault detecting relay such as DC earth fault relay and DC No voltage relay shall be equipped with operation indicators. The operation indicator shall be preferably mechanically operated type and secured against unwarranted operation by vibration. All indicators and hand reset contacts shall be capable of being reset without opening the relay case. The contacts for Audio visual alarm shall be provided. In case of DC earth fault relay the setting adopted for operating the relay should be indicated on the relay. DC under voltage relay shall drop out at about 85% of the DC system voltage.

4.4.7: The relays shall be draw out type and shall be supplied in cases flush mounted on steel panels.

4.4.8: Approved make of relays are as under:

(I) ALSTOM.
(II) ABB.
(III) JVS.
(IV) EASUN REYROLLE.

4.5 AMMETER AND VOLTMETER:

4.5.1: Moving coil Indicating ammeter/voltmeter alongwith selector switch should be provided to measure the load currents and voltages between the battery terminals, between the positive terminal to earth and between negative terminal to earth.

4.5.2 The ammeter/voltmeter shall be of switch board type back connected suitable for flush mounting and provided with dust and vermin proof case for tropical use and finished in suitable colour. It shall be 144x144 mm square pattern moving coil type and shall conform to the provisions of the latest edition of IS:2419/1963.

4.5.3 The limits of errors for ammeter/voltmeter shall be those permissible for class-I instruments of switch board type given in IS:1248. The instruments shall be magnetically shielded.

4.6 GENERAL PANEL CONSTRUCTION:

4.6.1 STANDARDS:

The panels offered should conform to relevant Indian standards or equivalent I.E.C. standards. The reference of the relevant standard specifications wherever mentioned in the text of this specification have been given accordingly. Other authoritative standards which ensure an equal or better quality than the standards specified will also be accepted.

4.6.2 GENERAL:

4.6.2.1: The DC control and distribution board shall be simplex type suitable for placement side by side with other C/R panels to form continuous boards. Lockable access doors with hinges having a swing of not less than 1050 mm shall be fitted on the back and interior shall be automatically lighted by the opening of these doors.
4.6.2.2: The DC board shall be of folded type construction. The front panels, base frame and door frame shall be manufactured from CRCA sheet steel plate 10SWG (3mm) thick while the side panels, roof and doors shall be manufactured out of 14SWG (2mm) thick CRCA sheet steel. The bottom of the cubicle frame shall be suitable for erection on flush concrete floor. Evenly spaced ground bolt projecting through the base channels forming members of the frame shall be used for securing cubicles to the floor. The dimensions of the DC control and distribution board where no specific matching is required shall be as follows:

(a) Height: 2312 mm (Inclusive of base channel height of 102 mm).
(b) Width: 610 mm.
(c) Depth: 610 mm.

4.6.2.3: The complete cubicle shall be dust and vermin proof be suitable for tropical use and shall provide degree of protection not less than IP-31 in accordance with IS:2147. All holes and extension windows in the panels shall be blanked and access doors shall be lined with compressible liders at the edges. The complete board shall incorporate all necessary MCCB’s power contactors, relays, fuses, switches, horizontal and vertical wiring support earth bars, interior lighting system, terminal blocks, Brass cable glands, labels, ferrule, space heaters and other necessary equipment.

4.6.2.4: The bottom plates of 4mm thickness shall be provided for making the base dust tight. Cable gland plates of 4mm thickness shall be provided on this bottom plate. Sufficient number of knockouts of appropriate diameter shall be provided on the gland plate for accommodating cable glands.

4.6.3 PAINTING:

(i) All sheet steel work shall be phosphated in accordance with IS:6005 code for practice for phosphating iron and steel.

(ii) Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

(iii) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with slightly alkaline hot water and drying.

(iv) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

(v) The phosphate coating shall be sealed with plication of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be 'flash dried' while second coat shall be stoved.

(vi) After application of primer two coats of finishing synthetic enamel paint shall be applied, each coat shall be applied followed by stoving the second coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be as per shade 631 of IS-5.

(vii) Each of coat of primer and finished paint shall be of slightly different shade to enable inspection of painting.

4.6.4 PANEL WIRING:

4.6.4.1: The main DC bus bars and the segregated bus shall be made of 25x6 mm tinned copper flat. The busbars shall be insulated using PVC sleeves. The colour of the sleeves shall be red on the positive bus and blue on the negative bus. The sleeves shall be cut only at the points where connections are to be made. All connections to the bus bars shall be made
by using brass bolts, nuts, plain washer & spring washer. The bus bars shall be rigidly supported by non-hygroscopic insulation material having high dielectric and mechanical strength. The bus bars shall be shielded with Bakelite sheet cover to safeguard against any inadvertent/ unintentional contact during maintenance, etc.

4.6.4.2: The wiring of the incoming DC supply circuit from the terminal blocks to the bus bars shall be carried out using 25 Sq. mm PVC insulated copper conductor (660 V service & in accordance with relevant ISS). The positive wire shall be connected through the external shunt of the ammeter. All main wiring for connection of MCCB’s to bus bar and terminal board shall be switch board type connecting or multi strand 4 sq. mm PVC insulated copper conductor suitable for 660 volt service and in accordance with relevant Indian standards. For auxiliary control circuit, the wiring will be done with 2.5 sq. mm insulated copper conductor and for alarm circuit same shall be done with 1.5 sq mm insulated copper conductor. Polyvinyl chloride used shall have excellent resistance against burning, moisture, oil and vermin and shall be furnished with clear colour. Rubber insulated wiring shall not be acceptable.

4.6.4.3: The wiring shall be supported by plastic cleats. The terminals blocks with (not soldered) copper ROSS Courtney/ tinned suitable claw washers, separate washers terminated. Wires shall be terminated on to the terminal blocks with insulated tinned copper solder less crimping type lugs. Wiring shall in general be accommodated on the sides of the cables and the wires for each circuit shall be separately grouped.

4.6.4.4: Wires shall not be jointed or tied between terminated points. At the terminals connections, washer shall be interposed between terminals and holding nuts. All holding nuts shall be secured by locking nuts. The connecting stud shall project at least 6 mm from the lock nuts surface.

4.6.4.5: All wiring diagram for the DC control volts shall be drawn as viewed from the back of the cubical and shall be accordance with the relevant IS.

4.6.4.6: Wiring connected to the space heater in the cubical shall have porcelain beaded insulation over a safe length from heater terminals.

4.6.4.7: All wires shall be suitable for bending to meet the terminal studs at right angles with the studs and they shall not be skewed. Metal cases of all apparatus mounted on panels shall be separately earthed by means of copper wire terminated on common earthing strip.

4.6.4.8: The following colour scheme of the wiring shall be used:

(1) AC CIRCUITS: BLACK.
(2) CONNECTION TO EARTH: GREEN.
(3) DC CIRCUITS:
   (a) POSITIVE: RED.
   (b) NEGATIVE: BLUE.

4.6.5 FERRULES:

4.6.5.1: Ferrules engraved with the same numbers, letters and symbols indicated in the connection and wiring diagrams shall be provided on the terminals ends of the all wires for easy identification of circuits for inspection and maintenance.

4.6.5.2: Ferrules shall of strong and flexible insulating material with glossy finish to prevent adhesion. They shall be engraved and clearly durably marked and shall not be affected by damages.
4.6.5.3: Ferrules numbering and identification suffix shall be in accordance with IS:11353. The same ferrules numbers shall not be used on wires in different circuits on a panel.

4.6.5.4: Ferrule number shall be provided on outgoing circuits as indicated against each in BOM indicated above.

4.6.6 TERMINAL BOARDS:

4.6.6.1: Terminal block connectors built from cells of moulded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the panels wirings and the corresponding incoming tail ends of control cables. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between the terminals shall be such as to give adequate protection and allowing easy access to terminals. Provision shall be made on each pillar for holding 10% extra connections. All blocks shall be shrouded by easily removable shrouds of non inflammable moulded and transparent dielectric materials.

The terminals block shall be suitable for 660 volts service and for connection with copper wires only.

4.6.6.2: Terminals boards shall be mounted in such a manner as to afford easy access to terminations and to enable ferrules number to be read without difficulty. Wire ends shall be so connected to the terminals that no wire terminals number gets obstructed due to succeeding connections. In other words ferrules numbering and terminals should be unambiguous and fool proof. Terminals board rows shall be adequately spaced and shall not be less than 100 mm apart so as to permit convenient access to wire and terminals. Labels in the form of engraved plastic plates shall be provided on the fixed portion of the terminal boards.

4.6.6.3: No live metal parts shall be exposed at the back of the terminals boards.

4.6.6.4: All studs, nuts, bolts, screws etc. shall be threaded according to the latest relevant Indian or equivalent international standards.

4.6.7 SPACE HEATER:

Tubular space heater suitable for connection to the single phase 230 volts AC supply complete with switches located at convenient positions shall be provided at the bottom of each cubical to prevent condensation of moisture. The watt loss per unit surface of heater shall be low enough to keep surface temperature well below visible heat. Each cubical shall also be provided with a switch of appropriate ratings for control of space heater.

4.6.8 CUBICAL LIGHTING:

The cubical interiors shall be illuminated by incandescent lamp connected to 230 volts single phase AC supply. The illumination of interior shall be free from hand shadow and shall be planned to avoid any strain or fatigue to the wireman who may be called upon to do work.

4.6.9 SAFETY EARTHING:

Earthing of current free metallic parts of metallic body of the equipment mounted on the DC control board shall be done with 6 sq. mm PVC insulated Green colour copper wire. The two ends of this line shall be provided with Ross Courtney/tinned copper lugs terminations and connected to a tinned copper earth bar of 25 x 3mm section running longitudinally at the bottom of the control boards.
5.0 INSPECTION AND TESTS:

5.1: Following tests shall be carried out at the manufacturer’s works after complete assembly of the DC control Board in the presence of RSDCL's representative.

(i) Routine test as per IS:8623 "Specification for factory built assemblies of switchgear and control gear for voltages upto & including 1000 V AC & 1200 V DC”.
(ii) One minute 2KV insulation withstand test at 50 cycles on all equipment of the panels and wiring.
(iii) Insulation resistance of complete wiring, circuit by circuit with all equipments mounted on the panel.
(iv) Checking the operation of MCCB’s and change over circuit and associated relays.
(v) Routine tests in accordance with relevant IS or other international standards shall be carried out on all the instruments, relays and other circuits.
(vi) The switch boards should also be physically examined for dimensional check up, sheet thickness & Bill of material as specified.

5.2 TYPE TEST CERTIFICATES:

The tenderer/manufacturer shall furnish the type test report/certificate for Degree of Protection test minimum IP-51 for cubicle from a Govt./Govt. approved/Govt. recognized/NABL accredited test lab, on any panel.

6.0 BOUGHT OUT ITEMS:

Only approved make bought out items as mentioned below shall be acceptable:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEM</th>
<th>APPROVED MAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MCCB</td>
<td>LG/L&amp;T/HAVELLS/SIEMENS</td>
</tr>
<tr>
<td>2.</td>
<td>POWER CONTACTOR</td>
<td>ABB/GE/L&amp;T/CGL/SIEMENS</td>
</tr>
<tr>
<td>3.</td>
<td>INDICATING LAMPS/LEDS</td>
<td>DAV/JVS/EASSUN/CONNECTWELL/ALSTOM/TEKNIC/VAISHNO</td>
</tr>
<tr>
<td>4.</td>
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7.0 GUARANTEE PERIOD:

The complete Panel including all accessories, fittings & Relays, to be supplied against this contract shall be guaranteed for a period of 30 Months from the date of commissioning or 36 Months from the date of supply at site whichever is earlier.
TECHNICAL SPECIFICATION FOR 220V-400AH STATIONARY VRLA BATTERY SETS

1.0 SCOPE:

The specification covers design, manufacture/fabrication, shop test and offer for inspection, testing and checking before delivery of stationary VRLA battery sets along with accessories duly packed suitable for indoor installation. These equipments are to be complete in every respect.

2.0 GENERAL:

The Battery sets to be supplied by the supplier shall meet the requirement of IS-15549: 2005/IEC 896-2:1995 & BS 6290 (Part-IV 1997) and shall be suitable for continuous operation for the climatic conditions specified in the specification. The batteries shall be suitable for float quick charging.

The Battery sets shall be maintenance free, sealed type in thermoplastic containers with minimum expected life of 15 years at 27 Deg.C. The batteries shall include battery mounting racks and other equipment required to provide a complete operational battery sub system. Battery sets shall be capable of operating at a peak ambient temperature specified in clause climatic conditions of the specification. The average ambient temperature is also specified there in. The offered battery shall be compact and shall require no regular maintenance. All safety equipment required for installation shall be provided by the manufacturer.

3.0 GENERAL REQUIREMENT OF BATTERIES:

Depending upon the situation, the batteries may be required to provide a back-up for 8, 24 or 48 hours. The Bidder shall furnish detailed battery sizing calculations along with all arrangements and supporting structures for each type of DC supply units being proposed. In all cases, the battery is normally not allowed to discharge beyond 80% of rated capacity of the battery at 10 hours rate of discharge.

The manufacturer supplying the cells/batteries as per this document shall be responsible to replace/repair free of charge, the battery/cell becoming faulty, owing to defective workmanship or material as per the provisions of the bid document.

4.0 All electrical and mechanical equipments shall be designed and manufactured so that no damage will result in transportation, installation and operation of the equipment under the climatic conditions to which it will be subjected.

5.0 STANDARD:

All material and equipments used for battery set shall comply in all respect with the requirements of the latest edition of the relevant Standards for sealed stationary VRLA batteries complying to IS-15549:2005/BS:6290 (part-IV 1997) and IEC 896-2/BSEN6089.2, IEEE-1188/ 1189.

6.0 MATERIAL AND CONSTRUCTION:

6.1 GENERAL:

The storage batteries should be fabricated with Flat pasted type positive plates and Flat pasted type negative plates as per relevant Standards and shall be assembled in hard containers of durable and robust construction.
The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. The cells shall be so designed as to be suitable of Horizontal/vertical Stacking.

6.2 CONTAINERS:

The containers material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28%. The porosity of the container shall be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such as to handle the internal cell pressure of the cells in the worst working condition. Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

6.3 CELL COVERS:

The cell covers shall be made of suitable material compatible with the container material and permanently sealed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant and shall comply with the provisions mentioned in clause 6.2 above. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

6.4 PRESSURE REGULATION VALVE:

Each cell shall be provided with a pressure regulation valve. The valve shall be self re-seal able and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

6.5 TERMINAL POSTS:

Both the positive and negative terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both positive and negative posts shall be clearly and unambiguously/identifiable. All exposed metal parts (connectors, terminals etc) shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

“Terminal shall be clearly and unmistakable identifiable and marking shall be of permanent nature”

6.6 CONNECTORS, NUTS & BOLTS, HEAT SHRINKABLE SLEEVES:

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connections of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge. The area of cross-section of the connectors shall be rated at 2 Amp/sq.mm minimum at 6 hour rate of discharge.
Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating.

All exposed metal parts (connectors, terminals etc.) shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

6.7 FLAME ARRESTORS:

Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrestor shall not affect the performance of the cell. The valve regulated venting device shall be provided with flame arrestors to prevent any sparking flame from entering the cell.

6.8 SEPARATORS:

The separators used shall be glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no mis-alignment during normal operation and handling.

6.9 STAND/SUPPORTING RACK:

Necessary stands/supporting racks for fixing and installing the batteries shall be supplied with cell insulators and stand insulators. These racks/stands shall be so designed that cells are placed within easy reach at convenient height to facilitate easy maintenance. Minimum number of screw should be used primarily for anchoring. The joining of the frames should not leaves crevices and ensures proper and tight fit. Necessary screws etc. should be supplied such that the racks can be fitted without any extra material. Racks shall be constructed so as to permit free access to the floor directly beneath, thus cleaning of both cells and floor is quick and simple task. Racks shall be duly painted with two (2) coats of acid resistance paint and supplied in assembled state with marking.

6.10 The battery will also be used for feeding light load in the control room when AC supply fails. The battery should be capable of float/quick charge when AC supply is restored.

7.0 RATINGS:

The rating of battery cells shall be 10 hrs. rating corrected to 27 deg. C. The Ampere-hour rating for 220V battery banks shall be 400AH. Each cell will be of 2.23/2.25 Volts under float operating condition. Thus the battery bank for 220V shall consist of 108 Cells, so that total battery voltage is not in excess of 10% of the rated voltage under float operating condition.

7.1 DESIGNATION: The cell shall be designated by symbol as per relevant Standards.

8.0 CAPACITY REQUIREMENT AND DIMENSIONS:

On the first discharge at 10 hour rate, the VRLA battery set shall deliver & minimum of 85% of the rated capacity (corrected to 27 Deg. Celsius) before any of the cells in the VRLA battery set reaches 1.75 V. The rated capacity shall be achieved within another 4 discharges (i.e. total 5 discharges). The capacity (corrected to 27 Deg. C.) shall also not exceed 120% of the rated capacity.

The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) at the specified float voltage. The battery design shall permit the charging of the Battery at 2.35V (For a short duration)/cell (when two cells shorted). All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.
The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:

(a) After Six minute of discharge : 1.98V  
(b) After Six hours of discharge : 1.92V  
(c) After 10 hours of discharge : 1.75V

The bidder shall provide the Tables & Graphs showing relation of the closed circuit voltage, impedance and the residual capacity of each cell in the battery, when it is discharged to the end voltage of 1.75V/cell at C/10 and C/8 rate of discharge. A table and graph showing the relation between the impedance and residual capacity of each cell shall also be provided.

Loss of capacity during storage at an average ambient temperature of 35 Deg. C for a period of 6 months shall not be more than 60% and the cells/battery shall achieve 85% of its rated capacity (corrected to 27 Deg. C) within one charge/discharge cycle, and full rated capacity within another 4 discharges (i.e. total 5 discharges) after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

9.0 EXPECTED BATTERY LIFE:

The battery for float applications shall be capable of giving more than 1200 DOD (upto 80%) cycles at an average temperature of 35 Deg. Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity.

10.0 CHEMICAL REQUIREMENTS:

Oxygen recombination efficiency of cells shall not be less than 90% when tested as per clause 12.9 of IS:15549: 2005. The cell pressure shall be sufficient for 99% gas recombination when working at C/10 rate of charge and ambient temperature of 27Deg. Celsius. Under normal operating conditions grid corrosion shall not be more than 0.05 mm/year.

Throughout its life, in the operating condition of C/10 rate of charge and C/8 rate of discharge in average ambient temperature of 35 Deg. Celsius, shedding of battery active material shall not lead to short circuit. The growth of positive plate shall be less than 8% of the total plate area throughout the specified life.

While operating in the normal operating conditions, the cell or battery shall not lead to dry out, throughout the life of the battery. Manufacturer shall supply the necessary data to support the requirement. The battery shall not exhibit thermal runaway while working in the average ambient temperature of 35 Deg. C, operating range of 0 to 50 Deg. C and at a charge rate of C/10 and discharge rate of C/8.

11.0 MARKING AND PACKING:

11.1 MARKING:

The following information shall be indelibly and durably marked on the outside of the cell:

(a) Nominal voltage.  
(b) Manufacturer’s name and trade name.  
(c) Cell designation.  
(d) AH capacity at 10 hour rate.  
(e) Voltage for float operation at 20 deg. C with tolerance of (+/-) 1%.  
(f) Month & Year of manufacture.
(g) Country of origin.
(h) Sr. No. of cell/cell No.
(i) Date on which charge given before dispatch.
(j) Next due date for freshening charge.

11.2 The cells and batteries may also be marked with the ISI certification mark, if any.

11.3 PACKING:

The cells shall be suitably packed so as to avoid any loss or damage during transit.

12.0 ACCESSORIES:

Each battery set shall be supplied complete with all necessary accessories viz. stand, interconnections, cell No. plates with Sticker, Digital multi meter complete with leads, spanners.

13.0 BILL OF MATERIAL:
The firm shall also have to furnish the bill of material used in battery set.

14.0 TYPE TEST CERTIFICATES:
The bidder/supplier shall submit the complete type test certificates as per relevant standards mentioned at Clause No. 5.0 above.

15.0 TESTS:

All the acceptance tests as per relevant standards mentioned at Clause No. 5 above shall be carried out for batteries in presence of our inspecting officer.

16.0 SAMPLING:
The sampling scheme and criteria for acceptance test for cells shall be in accordance with Clause 14 of IS-15549: 2005.

17.0 GUARANTEE PERIOD:
The guarantee period of each Battery set shall be 24 Months from the date of commissioning or 30 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATIONS FOR 48 VOLT 360 AH MAINTENANCE FREE BATTERY SETS

1.0 SCOPE:

This specification covers design, manufacture, assembly, inspection & testing of maintenance free battery sets along with accessories duly packed suitable for Indoor installation. These equipments are to be complete in every respect, details of the functions designated to the entire satisfaction of the purchaser. The erection/ maintenance tools and specific tools if any will also form part of supply.

2.0 GENERAL:

The battery sets to be supplied by the supplier shall meet the requirement of IS-15549:2005 & shall be suitable for continuous operation for the climatic conditions specified in the specification. The batteries shall be suitable for float quick charging. The floating voltage shall be regulated to be within (+/-) 1% of the normal voltage when the required load is discharged by the battery.

Battery sets shall be maintenance free, sealed type in thermoplastic containers with minimum expected life of 15 years at 27 Deg. C. The batteries shall include battery mounting racks and other equipment required to provide a complete operational battery system. Battery sets shall be capable of operating at a peak ambient temperature as specified in specification. The average ambient temperature is also specified in specification. The offered battery shall be compact and shall require no regular maintenance. All safety equipment required for installation shall be provided by the manufacturer.

3.0 GENERAL REQUIREMENT OF BATTERIES:

Depending upon the situation, the batteries may be required to provide a back-up for 8, 24 or 48 hours. The Bidder shall furnish detailed battery sizing calculations along with all arrangements and supporting structures, for each type of DC supply units being proposed. In all cases the battery is normally not allowed to discharge beyond 80% of rated capacity of the battery at 10 hours rate of discharge.

The manufacturer supplying the cells/batteries as per this document shall be responsible to replace/repair free of charge, the battery/cell becoming faulty, owing to defective workmanship or material as per the provisions of the bid document.

4.0 All electrical and mechanical equipments shall be designed and manufactured so that no damage will result in transportation, installation and operation of the equipment under the climatic conditions to which it will be subjected.

5.0 STANDARD:

All material and equipments used for battery set shall comply in all respect with the requirements of the latest edition of the relevant Standards for sealed stationary VRLA batteries complying IS-15549:2005.

The tenderer/supplier shall however furnish all the necessary type test reports/literature and past performance reports of the type of batteries offered.

6.0 MATERIAL AND CONSTRUCTION:

6.1 GENERAL:
The storage batteries should be fabricated with Flat pasted type positive plates and Flat pasted type negative plates as per relevant Standards and shall be assembled in hard containers of durable and robust construction.
The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. The cells shall be so designed as to be suitable for Horizontal/vertical Stacking.

6.2 CONTAINERS:

The containers material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28%. The porosity of the container shall be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such as to handle the internal cell pressure of the cells in the worst working condition. Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

6.3 CELL COVERS:

The cell covers shall be made of suitable material compatible with the container material and permanently sealed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant and shall comply with the provisions set forth in clause of 6.2 above. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

6.4 PRESSURE REGULATION VALVE:

Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

6.5 TERMINAL POSTS:

Both the positive and negative terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both positive and negative posts shall be clearly and unambiguously/identifiable. All exposed metal parts (connectors, terminals etc) shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment. “Terminal shall be clearly and unmistakable identifiable and marking shall be of permanent nature”.

6.6 CONNECTORS, NUTS & BOLTS, HEAT SHRINKABLE SLEEVES:

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connections of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge. The area of cross-section of the connectors shall be rated at 2 Amp/sq.mm minimum at 6 hour rate of discharge.
Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating.

All exposed metal parts (connectors, terminals etc.) shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

6.7 FLAME ARRESTORS:

Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrestor shall not affect the performance of the cell. The valve regulated venting device shall be provided with flame arrestors to prevent any sparking flame from entering the cells.

6.8 SEPARATORS:

The separators used shall be glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no mis-alignment during normal operation and handling.

6.9 STAND/SUPPORTING RACK:

Necessary stands/supporting racks for fixing and installing the batteries shall be supplied with cell insulators and stand insulators. These racks/stands shall be so designed that cells are placed within easy reach at convenient height to facilitate easy maintenance. Minimum number of screw should be used primarily for anchoring. The joining of the frames should not leave crevices and ensure proper and tight fit. Necessary screws etc. should be supplied such that the racks can be fitted without any extra material. Racks shall be constructed so as to permit free access to the floor directly beneath, thus cleaning of both cells and floor is quick and simple task. Racks shall be duly painted with two (2) coats of acid resistance paint and supplied in assembled state with marking.

7.0 RATINGS:

The rating of battery cells shall be 10 hrs. rating corrected to 27 deg. C. The Ampere-hour rating for 48V battery banks shall be 360 AH. Each cell will be of 2.23/2.25 volts under float operating condition. Thus, the battery bank for 48V shall consist of 24 cells so that the total battery voltage is not excess of 10% of the rated voltage under float operating condition.

7.1 DESIGNATION: The cell shall be designated by symbol as per relevant Standards.

8.0 CAPACITY REQUIREMENT AND DIMENSIONS:

When the battery is discharged at 10 hour rate, it shall deliver 85% of C (rated capacity, corrected at 27 Deg Celcius) before any of the cells in the battery bank reaches 1.85 V/cell. The capacity (corrected at 27 Deg. Celsius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75 V/cell.

The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) at the specified float voltage. The battery design shall permit the charging of the battery at 2.35V (For a short duration)/cell (when two cells shorted). All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.

The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:
The bidder shall provide the Tables & Graphs showing relation of the closed circuit voltage, impedance and the residual capacity of each cell in the battery, when it is discharged to the end voltage of 1.75V/cell at C/10 and C/8 rate of discharge. A table and graph showing the relation between the impedance and residual capacity of each cell shall also be provided by the bidder. Loss of capacity during storage at an average ambient temperature of 35 Deg. Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity (corrected to 27 Deg. Celsius) within one charge/discharge cycles and full rated capacity within another 4 discharges (i.e. total 5 discharges) after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period.

Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

9.0 EXPECTED BATTERY LIFE:

The battery for float applications shall be capable of giving more than 1200 DOD (upto 80%) cycles at an average temperature of 35 Deg. Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Amphere-hour) removed from a cell or battery on discharge to its rated capacity.

10.0 CHEMICAL REQUIREMENTS:

Oxygen recombination efficiency of cell/battery shall be Less than 90% when tested as per clause No. 12.9 of IS-15549:2005/clause No.7.6.4.1TEC SPEC.GR/BAT-01/03,march-04. The cell pressure shall be sufficient for 99% gas recombination when working at C/10 rate of charge and ambient temperature of 27Deg. Celsius. Under normal operating conditions grid corrosion shall not be more than 0.05 mm/year.

Throughout its life, in the operating condition of C/10 rate of charge and C/8 rate of discharge in average ambient temperature of 35 Deg. Celsius, shedding of battery active material shall not lead to short circuit. The growth of positive plate shall be less than 8% of the total plate area throughout the specified life.

While operating in the normal operating conditions, the cell or battery shall not lead to dry out, throughout the life of the battery. Manufacturer shall supply the necessary data to support the requirement. The battery shall not exhibit thermal runaway while working in the average ambient temperature of 35 Deg. C, operating range of 0 to 50 Deg. C and at a charge rate of C/10 and discharge rate of C/8.

11.0 MARKING AND PACKING:

11.1 MARKING:

The following information shall be indelibly and durably marked on the outside of the cell:

a) Nominal voltage.
b) Manufacturer’s name, type and trade name.
c) Cell designation.
d) AH capacity at 10 hour rate.
e) Voltage for float operation at 20 deg. C. with tolerance of (+/-) 1%.
f) Month & Year of manufacture.
g) Country of origin.
h) S. No. of cell/cell No.
i) Date of which charge given before dispatch.
ii) Next due date for freshening charge.

11.1.1 The cells and batteries may also be marked with the ISI certification mark, if any.

11.2 PACKING:

The cells shall be suitably packed so as to avoid any loss or damage during transit.

12.0 TYPE TESTS:

The following type tests should have been carried out on the battery sets offered:

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<td>Test for oxygen recombination efficiency</td>
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<td>7.6.4.1</td>
</tr>
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<td>Not available</td>
<td>5.10,5.10.1,3.6 &amp; 7.6.3.9</td>
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</table>

The bidder/supplier will submit the complete type test certificates as per relevant standard mentioned for battery sets. The type test(s) conducted at manufacturer’s works duly witnessed by representative of any Electricity Board/Govt. Company/Govt. Agency/PGCIL/ NTPC will also be acceptable.

13.0 ACCEPTANCE TESTS:

All the acceptance tests listed below shall be carried out as per IS 15549: 2005 and relevant standards for batteries in the presence of our inspecting officer:

1. Visual Inspection
2. Verification of dimensions
3. Test for “C10” capacity and voltage during discharge.

14.0 DRAWINGS:

The tenderer/supplier will submit the detailed dimensional drawings for battery sets including stands.
15.0 **ACCESSORIES:**

Each battery set shall be supplied complete with all necessary accessories viz. stand, interconnections, cell No. plates with Sticker, cell tester (3-0-3 Volt) with leads/digital multimeter with leads, spanners etc.

16.0 **BILL OF MATERIAL:**

The firm shall also have to furnish the bill of material used in battery set.

17.0 **SAMPLING:**

The sampling scheme and criteria for acceptance test shall be in accordance with clause 14 of IS-15549:2005.

18.0 **GUARANTEE PERIOD:**

The guarantee period of each Battery set shall be 24 Months from the date of commissioning or 30 Months from the date of receipt of last consignment at site, whichever is earlier.
1.0 SCOPE:

1.1 This specification provides for the design, engineering, manufacture, fabrication, assembly, shop testing, inspection & testing before dispatch of battery chargers & accessories suitable for indoor installation.

1.2 It is not the intent to specify completely herein all the details of design and construction of Battery charger. However, battery chargers shall conform in all respects to the high standard of design & workmanship and be capable of performing in continuous commercial operation upto bidder's guarantee in a manner acceptable to RSDCL. The battery chargers offered shall be complete with all parts, necessary for their effective and trouble free operation.

2.0 STANDARD:

All materials and equipment shall comply in all respect with the requirements of the latest editions of the relevant Indian Standards or in the absence of the requisite Indian Standard, to relevant British Standards except in so far as they are modified in these specifications. Alternatively all materials and equipments shall be designed and manufactured in accordance with the standards of the International Electro technical Commission (IEC) or the American Standards specification or the appropriate German or Swiss Standards. Where a certain equipment is stated not to comply with the Indian Standard or in the absence or requisite Indian Standards to the relevant British Standards the salient points of difference, merits and demerits between standards adopted and the Indian Standards or the British Standards shall be clearly brought out making at the same time, due correction for operation under the climatic conditions specified in the specification.

3.0 GENERAL TECHNICAL REQUIREMENT:

3.1 GENERAL REQUIREMENTS:

3.1.1 The materials and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment are deemed to be included in the scope of supply unless specifically excluded.

3.1.2 Unless otherwise brought out separately by the Bidder in the schedule of deviations, the Battery charger offered shall conform to the specification scrupulously.

3.2 PRINCIPAL PARAMETERS:

The battery chargers to be offered under this specification shall conform to the parameters given below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rated Voltage</td>
<td>220V</td>
</tr>
<tr>
<td>2. Ampere hour rating of the battery set to be charged</td>
<td>400AH</td>
</tr>
<tr>
<td>3. Input supply to the battery charger</td>
<td>3 phase, 50 Hz, 415V AC</td>
</tr>
<tr>
<td>4. Charging capacity:</td>
<td></td>
</tr>
<tr>
<td>a) Float Charger</td>
<td>60A</td>
</tr>
<tr>
<td>b) Boost Charger</td>
<td>80A</td>
</tr>
<tr>
<td>5. Ripple content (in float and boost section both):</td>
<td>Less than 25%</td>
</tr>
<tr>
<td>a) Load current</td>
<td></td>
</tr>
<tr>
<td>b) Output voltage across the load.</td>
<td>Less than 2%</td>
</tr>
</tbody>
</table>

4.0 TECHNICAL REQUIREMENTS:
4.1.1 The battery chargers to be supplied by the supplier shall meet the requirements of any of ISS if comes later on for battery chargers at the time of supply. The battery chargers shall be constant potential type with current and voltage limiting facility and shall meet the requirements of clause 6 of IS-15549:2005 (specification for stationary VRLA battery). Battery chargers shall be of sufficient capacity to suit battery sets.

4.1.2 The equipment shall be suitable for float charging, as well as quick charging of associated battery sets of 220V-400AH ratings. The bus bar voltage shall be maintained at all times even during quick charging. The float voltage to the load shall be maintained within +/- 1% of the set voltage at all times even during boost charging. The float section as well as the boost section of the charger shall be silicon Control Rectifier (SCR) based to control the voltage as per requirement of the load/ VRLA battery set.

4.1.3 The battery charger shall be capable of recharging the battery within 12 to 16 hours from a completely discharged conditions i.e. the float charger should be capable of charging the batteries from 1.75 volts per cell to 2.30 volts per cell and boost charger should be capable of charging the batteries from 1.75 Volts per cell to 2.35 volts per cell.

4.1.4 During normal working conditions, the float charger shall supply the load current and also keep the batteries on 'Float'. The boost charger will remain off under these conditions. During failure of mains supply, the load be automatically fed by the batteries (time delay not permitted).

4.1.5 On resumption of supply, the batteries may need to be boost charged. For this the Boost charger should be switched on to boost the batteries. The Boost charger should be SCR controlled type and its output voltage be available from 1.75 V per cell to 2.35 V per cell.

However, under Boost charge condition, the voltage across the load should not exceed the rated value. The Battery charger construction shall be such that every time when it is switched ON, it shall charge the battery set at the selected voltage at a boost rate not exceeding 80A (for 220V battery set) The voltage shall also not exceed 2.30 Volt per cell.

However, every time when the float charger is switched ON, or restoration of A.C. supply takes place after a failure the float charger shall charge the battery set to the rated/ set voltage without exceeding the limits of the charging current.

4.1.6 The float section of the charger suitable for 400AH batteries shall be capable of delivering a continuous load of 60 A. The boost section shall be capable of delivering a continuous load of 80 Amps.

4.1.7 Battery charging equipment causing unbalance in charging current of various cells of the battery shall not be acceptable. All cells will receive adequate and permissible value of charging current. There should not be any discontinuity of DC supply to the bus bar during any transition period and battery power should be available for tripping circuit, if necessary, even during quick charging.

4.1.8 The float & boost section of the battery charger should able to stabilize the DC output voltage within plus minus 1% and with the variation of plus minus 10% in the AC supply with simultaneous load variation from 0 to 100% of rated current. The efficiency of Float & Boost charger shall not be less than 85% at rated voltage & rated load conditions.

Both float charger and boost charger shall be provided with temperature compensation feature so as to protect VRLA batteries (and hence enhance battery life) against temperature variation. It should increase or decrease the output voltage depending upon the situation whether Temp. is below or above 27 Deg. C respectively. The circuit should have a Temp. sensor and be supplied with min. 10 meter long cable. Its function should be:
(a) To decrease the output voltage if the temperature increases beyond 27 Deg. C such that for every 1 Deg.C increase in ambient, the output voltage should decrease at the rate of 3 mV ± 15% per cell.

(b) Similarly, to increase the output voltage if the temperature decreases beyond 27 Deg. C such that for every 1 Deg. C decrease in ambient, the output voltage should increase at the rate of 3 mV ± 15% per cell. However, in both the cases the output voltage should not fall below 2.15V or go beyond 2.35 V per cell.

Normally, the charging voltages to be set in charger at 27 Deg. C are as under:

(i) Float Voltage = 2.23/2.25± 0.02 x Nos. of Cells
(ii) Boost Voltage = 2.30 ± 0.02 x Nos. of Cells.
(iii) The battery charger shall also have the following feature:
- Higher voltage cut off at 2.35 volts per cell.
- Lower voltage cut off at 1.70 volts per cell.

4.1.9 Automatic run down circuit shall be provided so that at the incidence of power failure, the DC output voltage of the float charger reaches the minimum position automatically and, therefore, when the power is resumed the voltage reaches a normal floating level from the minimum voltage slowly, by which the excessive in-rush current into the discharged battery is minimized.

4.1.10 Current limiting circuit shall be provided to protect the float charger & boost charger.

4.1.11 Keyed push button arrangement shall be provided by which the boost charger can be used as a float charger whenever the float charger is down due to any defect or failure.

4.2 CONSTRUCTION:

4.2.1 The rectifier used in the battery charger shall be of robust construction and shall preferably be of silicon type. The tenderer/supplier shall supply the characteristics of the rectifier used in the construction of the charger indicating the capacity of the rectifier to suit the temperature conditions.

4.2.2 Suitable constant potential & current limiting controllers shall be provided for maintaining constant voltage across float charger & boost charger & for maintaining the current within permissible/set values. The control for the voltage settings shall be provided on the front panel side of the battery charger.

4.2.3 The float charger should have provision for changing over to the manual mode, in case the electronic circuit stabilizing the DC output fails. For this purpose, suitable Arrangement should be made to trigger/fire the Silicon Controlled Rectifiers (SCR) in the manual position also. Also facility should be provided to prevent the excessive in rush current into the battery, when the discharged battery suddenly comes across the float charger after an emergency period. The ripple content of the output across load (in float and Boost section) shall be less than 2%.

4.2.4 The DC voltmeter with a range of 0-300 V DC and ammeters (shunt operated) with a range of 0-100A of accuracy 1.5 shall be provided. The charger shall be complete with the necessary Transformer, chokes, capacitors input output switches etc. The ripple content of the output across load in boost charger should be less than 2% (maximum). An AC voltmeter of class of accuracy 1.0 with selector switch shall also be provided at AC incoming supply. An ammeter is also to be provided in Boost charger. Weak links such as fuses, relays etc. shall not be provided between the chargers, batteries and load to ensure continuity of DC supply. However, suitable AC/DC switches/contacts of appropriate rating shall be provided to cut off AC/DC supply for repair and maintenance, if considered
so necessary. In that case, the battery would directly feed the load. Indicating lamps (Red, yellow, blue) be provided to indicate 3 phase AC supply.

4.2.5 All the electronic components shall be of high MTBF or heavy duty type and liberally rated. These shall be housed in a well ventilated sheet steel cubicle complete with input and output terminals. The charger shall be assembled in a sheet steel cubicle with suitable angle iron structure. Louvres will be provided for ventilation backed up by fine wire mesh. The thickness of the CRCA sheet steel used for cubicle shall be as follows:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Battery charger suitable for</th>
<th>Thickness of the sheet steel for Door Frame/ Front/ Top/Bottom Sides/Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>220 V-400 AH Batteries</td>
<td>2mm 1.6 mm</td>
</tr>
</tbody>
</table>

4.2.6 The unit shall be provided with audio and visual alarm for the following faults:

a) Input supply fuse failure float.
b) Input supply fuse failure boost.
c) Float charger rectifier fuse fail.
d) Boost charger rectifier fuse fail.
e) AC mains failure.
f) Condenser fuse failure.
g) The audio alarm shall ring under any fault conditions.
h) The audio alarm shall ring under any fault conditions “Even if one alarm exists, any or all other alarm shall be annunciated (audio and visual both).

4.2.7 The unit shall have Potential free contacts of Voltage and Current transducers for Net Work Panel:

(a) 220 V DC over voltage.
(b) 220 V DC under voltage.
(c) 220 V Battery Charger Mains AC fail.
(d) 220 V Battery full charged.
(e) 220 V Float Charger DC fail.
(f) 220 V DC Earth leakage.

4.3 TEMPERATURE RISE:

The temperature rise of various components after a heat run test on rated load shall not exceed the value as given below:

<table>
<thead>
<tr>
<th>Components</th>
<th>Max. permissible rise above ambient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformers &amp; Chokes with Class ‘F’ insulation</td>
<td>90 deg. C</td>
</tr>
<tr>
<td>Sillicon diodes, Zener diodes</td>
<td>70 deg. C</td>
</tr>
<tr>
<td>Thyristers (Sillicon controlled rectifiers)</td>
<td>50 deg. C</td>
</tr>
</tbody>
</table>

4.4 DANGER LABEL:

Each equipment shall have “Danger 415V” label suitably marked in a prominent place with red characters against white back ground.

4.5 CIRCUIT DIAGRAM:
A laminated circuit diagram of the equipment in each unit shall be fixed permanently at a convenient place inside the cubicle.

4.6 **NAME PLATE:**

The battery chargers shall be provided with non-corrosive legible name plate indelibly marked with the following information:
1. Rajasthan Solar Park Development Company Ltd.
2. Order No.
3. Manufacturer's name or trade mark and identification No. of the Battery Charger being supplied.
4. Rating of charger: (a) Float and (b) Boost
5. Input voltage
6. Output voltage & current.
7. Year of manufacture.

5.0 **TESTS:**

5.1 For battery charger shall be suitable for 220V-400AH VRLA Maintenance free batteries.

5.1.1 If there is no Indian Standards & Specification for battery charger, the following tests shall be carried out on each charger in presence of our Inspecting Officer:-

   a) No load test.
   b) Load test.
   c) Insulation resistance test.
   d) High voltage test at 2 KV for one minute.
   e) General performance test at various loads.
   f) Dimensional checking and sheet steel thickness measurements.
   g) Checks on annunciation circuits.

5.1.2 In addition to the tests indicated at clause 5.1.1 above, the ‘Efficiency’ & ‘Temp. rise’ tests shall be carried out as type test on one number charger in presence of RSDCL’s representative.

6.0 **INSPECTION:**

   (i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the Battery Chargers are being manufactured and the Supplier shall provide all facilities for unrestricted inspection of the Supplier’s works, raw materials manufacture of the equipment, all the accessories and for conducting necessary tests as detailed herein.

   (ii) The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.

   (iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

7.0 **GUARANTEE PERIOD:**

The guarantee period of each Battery Charger shall be 24 Months from the date of commissioning or 30 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR 48 VOLT SMPS BATTERY CHARGER SUITABLE FOR VRLA MAINTENANCE FREE BATTERY SET

1.0 SCOPE:

This specification covers design, manufacture, fabrication, shop test of SMPS battery chargers suitable for indoor installation. These equipments are to be complete in every respect for the functions designated and to the entire satisfaction of the purchaser. Consideration may be given by the purchaser to alternatives which the supplier considers advisable by reason of his own manufacturing requirements and experiences provided descriptive matter is submitted pointing out the recommended device or arrangement as equal to or superior to that required by the accompanying specification with full justification.

2.0 STANDARDS:

All material and equipment shall comply in all respect with requirement of the latest addition of the relevant IS/IEC/TEC/RDSO. A set of standards adopted, translated in English, if it is in language other than English, shall also be enclosed, to enable due comparison, wherever a standard is specifically mentioned in these specification. It is understood that the corresponding standard amongst the sources mentioned above shall also apply.

3.0 MANUFACTURERS PRACTICE:

All material used in the construction of the material shall be originally new, unused and shall comply with the standard and codes specified above and shall be selected from the best available considering strength, durability and best engineering practice, it will not deteriorate or distort under the prevailing extremes of atmosphere conditions. The workmanship and design shall be in accordance with the best engineering practice and shall be such as have been proved suitable for the tender purpose and for giving satisfactory performance under the prevailing climate conditions and proposed system of supply liberal factors of safety shall be used through out of the design and special consideration shall be given on parts subject to alternating stresses or shocks or most severe operating conditions.

4.0 GENERAL TECHNICAL REQUIREMENT:

The battery chargers of 48V, 50 Amp. in N+1 configuration with ultimate capacity 75 Amp. shall be of SMPS type with type with +ve earth. The system shall consist of a Distribution/ Switching/ Alarm arrangement (DSA) and Float Rectifier-cum-Chargers (FR/FCs) in a rack. It shall employ modular configuration for flexible provision of DC power. It shall employ menu driven Micro Processor Controlled Techniques for DSA as well as module for control, monitoring and alarm to achieve better reliability of the system. The SMPS battery chargers shall be capable of continuous operation with float voltage 2.23 to 2.25 volts per cell (at 27 Deg. C) and 2.3 volt per cell (at 27 Deg. C) for charge voltage while supplying the constant DC load.

4.1 The SMPS battery chargers shall have constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the maintenance free type VRLA batteries fully charged but without harmful overcharge.

The system shall employ a modular configuration to provide flexibility in view of the future load requirements of DC power. The modules shall be accommodated in a rack. Distribution/ Switching/ Alarm (DSA) shall be provided in first rack or in a separate rack as per manufacturer’s design for the ultimate system capacity. All factory wiring for the rack shall be for the ultimate capacity so that only plugging-in of FR/FC module shall enhance the DC power output.
4.2 PRINCIPAL PARAMETERS:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Nominal voltage</td>
<td>230 Volt +/-10% AC Single Phase for module of 25 Amp. for ultimate capacity of 50 Amp.</td>
</tr>
<tr>
<td>Input Voltage range</td>
<td>165 V to 260 V AC</td>
</tr>
<tr>
<td>Frequency</td>
<td>48 Hz to 52 Hz.</td>
</tr>
<tr>
<td>Power factor</td>
<td>&gt;0.95 at 50% and above load.</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt;0.85 at 50% and above load.</td>
</tr>
<tr>
<td>Soft Start time</td>
<td>10 Secs. Min. output current ramp-up.</td>
</tr>
<tr>
<td>Output voltage adjustable</td>
<td>48V to 56V DC</td>
</tr>
<tr>
<td>Current limit adjustable for 50 Amp. SMPS</td>
<td>5A to 50A</td>
</tr>
<tr>
<td>Regulation:</td>
<td></td>
</tr>
<tr>
<td>(i) Output voltage over shoot/under shoot when charger is switched on</td>
<td>+/-5% of DC output voltage for any load of 25% to 100%.</td>
</tr>
<tr>
<td>(ii) DC output voltage over shoot for a step change in AC voltage 165 V to 260 V single phase.</td>
<td>+/- 5% of DC output voltage for any load of 25% to 100%.</td>
</tr>
<tr>
<td>(iii) DC output voltage for a step load change of 25% to 100%</td>
<td>+/- 5% of DC output voltage for any load of 25% to 100%.</td>
</tr>
<tr>
<td>Ripple</td>
<td>&lt; 2mV RMS psophometric</td>
</tr>
<tr>
<td>Load sharing</td>
<td>Better than +/- 5% active current sharing at full load.</td>
</tr>
<tr>
<td>Cooling</td>
<td>Convection</td>
</tr>
</tbody>
</table>

4.3 MAIN FEATURES OF SMPS CHARGER:

4.3.1 CONSTRUCTIONAL FEATURES:

The rack structure shall be made up of rigid frame work of steel profiles and rear door may be of hinged or removable type. The rear door shall be provided with ventilation arrangement. Alternate design of aluminium and other rigid structure meeting the requirements are also permitted.

The rack shall be free of sharp edges or sharp corners. The rack shall be designed for easy maintenance & installation. The rack mounting arrangement shall be such as to provide easy access from front, rear and top for installation and maintenance.

The individual FR/RC module shall be easily mounted to / removed from the front side of the rack. The FR/FC module shall be designed to slide in to the rack on a suitable mechanical arrangement. The associated AC input, DC output connections, control / systems & interface cable connecting the modules shall be connected/ disconnected easily without causing any interruption in the supply and damage to load or other working module.

Proper thermal engineering of hardware design shall be done by the manufacturer so as to ensure the uninterrupted use of the equipment. The rack complete with all panels fitted shall be designed to allow cooling by natural convection.

With the doors in position, all the common visual alarms and meters shall be clearly visible. However, the fixtures on the door shall not restrict the movement of door in any way.

The FR/FC modules shall be cooled by natural convection. AC input to FR/FC shall be through locking type arrangement. DC output shall be through hot plug in connector on the FR/FC side and through lugged termination on the bus bar/ termination end. Control alarm and monitoring connection shall be through connectors. The FR/FC module shall be
removable from the rack only. All AC input, DC output & alarm /control/ monitoring cables interconnecting the modules and rack shall be easily disconnected by plugs or connectors.

**AC TERMINATIONS:**

The input terminals shall be single phase or three phases as the case may be clearly marked as R Y B and N for AC three phase, L and N for AC single phase.

AC input termination shall be suitably protected against the accidental touch/ contact with the working staff for their protection and shall also have clear and prominent be “DANGER” marking. Screening shall be provided between AC and DC components to prevent accidents.

The AC input connection to the rectifier module shall be by means of locking type plug and socket arrangement. All the connection between distribution and FR/FC shall be through proper rated cables only. Fuses and circuit breakers for each FR/FC shall be easily accessible and properly rated. Proper termination for the AC input of the circuit breakers and its output to the FR/FC.

**DC TERMINATIONS:**

The output of each rectifier in the negative load shall be taken through full rated ISI marked MCBs. All the AC, DC control & alarm cabling shall be supplied with the rack. All DC +Ve and -ve leads shall be clearly marked.

**WIRING:**

All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current and voltage during fault and overload. All the wires and cables used shall be fire retardant as per IS 1554 with amendment. All wiring shall be neatly secured in position and accurately supported. Where wires pass through any part of metal or cover the holes through which they pass shall be suitably bushed.

**EARTHING:** Two power earth terminals shall be provided in the frame of the system.

**MOUNTING OF COMPONENT & LAYOUT:**

Components mounting and fixing methods shall be secured. Suitable mechanical structure/ arrangement for holding modules in position shall be provided so that the module is held firmly by sliding through it.

The FR/FC modules shall be cooled convection. AC input to FR/FC shall be through locking type arrangement. DC output shall be through hot plug in connector on the FR/FC side and through lugged termination on the bus-bar termination end. Control, alarm and monitoring connections shall be through connectors.

The FR/FC module shall be removable from the front of the rack only. All AC input, DC output and alarm/ control/ monitoring cables interconnecting the modules and racks shall be easily disconnected by plugs or connectors.

**4.3.2 DISTRIBUTION, SWITCHING, CONTROL, ALARM & MONITORING (DSA):**

The Distribution/ Switching sub-system of DSA shall preferably be in the modular from whereas control, alarm & monitoring sub-system shall only be modular. The distribution/ switching sub-system may be accommodated in a rack with other FR/FCs or in a separate rack. These sub systems shall be rack mountable. DSA shall preferably be housed in the
upper portion of the rack above the FR/FC modules. The unit shall be equipped to meet the ultimate system capacity.

4.3.3 BATTERY TEMPERATURE COMPENSATION:

The charger shall be provided with the appropriate circuitry to interface with the temperature probe assembly. With the probe, the charger shall automatically compensate gassing and constant voltage setting inversely proportional to the probe’s temperature/battery ambient temperature, so that over charging at high temperature and under charging at low temperature can be prevented.

4.3.4 CURRENT LIMITING (VOLTAGE DROP):

Current Limiting (Voltage Drop) shall be provided for float/charge operation. The float/charge limiting shall be continuously adjustable between 50% to 100% of rated output current for output voltages range of 44.4 to 56 volt. For test purposes, the upper limit of 100% +5% and lower limit of 50% - 5% shall be acceptable.

The float and charge current limit adjustment shall be provided on the front panel of the rectifier module.

The FR/FC modules shall be fully protected against short circuit. It shall be ensured that short circuit does not lead to any fire hazard.

4.3.5 FUSES:

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. Fuse rating shall be chosen by the Bidder depending on the circuit requirement. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

4.3.6 BLOCKING ARRANGEMENTS:

Blocking arrangement shall be provided in the positive pole of the output circuit of the charger to prevent current flow from the DC battery into the charger.

4.3.7 MONITORING, ALARM AND INDICATING LAMPS:

The visual indications/display such as LEDs, LCDs or a combination of both shall be provided on each FR/FC module to indicate:

(A) FUNCTIONAL INDICATIONS:

The following functional indications shall be provided on FR/FC and DSA:

a) Mains available.
b) FR/FC on Auto Float.
c) FR/FC on Auto charge.

Note: The functional indication (a) shall be provided on both DSA & FR/FC module, while (b) and (c) may be provided either on DSA or on both FR/FC & DSA.

(B) ALARM INDICATIONS:

(i) On FR/FC:
(a) FR/FC over voltage, under voltage or output fail.
(b) FR/FC over load (voltage drop).

Functional indications shall be extended as status and alarm indications as FR/FC fail to Distribution/switching/control & alarm unit.

(ii) On DSA:
   (a) Load voltage high (above 56V/low (below 45.6V)
   (b) FR/FC Fail.
   (c) Mains out of range.
   (d) System over load.
   (e) Mains ON/Battery Discharge.
   (f) Temp. Compensation fail.
   (g) Battery Fail or No Battery.
   (h) Battery isolated from the load.

(iii) The unit shall have Potential free contacts of Voltage and Current transducers for Network Panel:

   (a) 48 V DC over voltage.
   (b) 48 V DC under voltage.
   (c) 48 V FR/FC Mains AC fail.
   (d) 48 V Battery full charged.
   (e) 48 V FC DC fail.
   (f) 48 V DC Earth leakage.

All alarm circuits shall be provided with suitable delay to ensure that they do not operate to transients.

All the protection/alarm shall be within tolerance of 0.25V in case of DC voltage and 1% in case of current. For AC voltage it shall be +/- 5V.

Every alarm condition shall be accompanied with an audio alarm with audio cut off facility. Potential free contacts two (one for alarm and one redundant) shall be provided for extension of alarms to centralized display.

4.3.8 RADIO INTERFERENCE:

The equipment shall be efficiently screened against interference to radio and also other communication equipment, which may be installed in the same building. All sources of noise shall be filtered if necessary with suppressors generally in accordance with relevant standards.

4.3.9 NAME PLATES AND MARKING:

The name plates shall be white with black engraved letters. On top of each charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the charger.

Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments and ease of operation and maintenance.

An etched, engraved or anodizer name plate shall be fitted on each SMPS battery charger unit having following details inscribed:

a) Manufacture’s name
b) P.O. No. & date
c) Sr. No. of SMPS unit
d) Rating of SMPS charger
e) Input voltage of SMPS charger
f) Output voltage of SMPS charger

g) Year of Manufacture

5.0 TESTS & INSPECTION:

The bidder must furnish type test reports carried out on one of the SMPS battery charger unit which shall pass all the prescribed type tests for conformity of relevant standards. These type test reports must be issued by a Govt./Govt. approved/ Govt. recognized/ Govt. accredited laboratory.

Battery chargers shall conform to all type tests as per relevant IS/ IEC and TEC specification No. GP/SMPS-01/04/ Feb. 2001 with all latest amendments. Routine/ acceptance tests shall also be carried out on each SMPS Battery Charger as per specification. Following type tests shall be carried out for compliance of specification requirements:

TYPE TESTS:

(I) Visual Inspection.

(II) Insulation Resistance Test.

(III) Applied high Voltage test.

(IV) Performance test.

(V) Test for protection device.

(VI) Burn in test.

(VII) Climatic test.

(VIII) Vibration test.

5.1 ROUTINE & ACCEPTANCE TESTS:

On each of the SMPS battery charger, the following routine and acceptance tests shall be carried out at manufacturer’s works before dispatch:

(i) Visual Inspection.

(ii) Insulation Resistance Test.

(iii) Applied high Voltage test.

(iv) Performance test.

(v) Test for protection device & other tests shall be carried out as per requirement of GTP in the presence of inspecting officer.

5.2 INSPECTION:

The inspection of the equipments shall be carried out by the RSDCL’s representatives in accordance to the relevant standards.

(i) The purchaser shall have access at all times to the works and all other places of manufacture, where the equipments are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the Supplier’s works, raw materials, manufacture of the material and for conducting necessary tests at any stage.

(ii) The supplier shall keep the purchaser informed in advance about the manufacturing programme so that arrangements could be made for inspection.

(iii) No equipments shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected, tested and cleared.

(iv) Inspection and acceptance of any quantity of equipment shall in no way relieve the Supplier from his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment is later found to be defective.
(v) The purchaser reserves the right to insist for witnessing the acceptance/ routine tests of brought out items.

TESTS AT SITE:

The purchaser reserves the right to conduct all the tests on the equipment after arrival at site and the supplier/contractor shall guarantee test certificate figures under actual service conditions.

6.0 DRAWINGS, LITERATURE AND MANUALS:

In addition to any other drawings which the tenderer/manufacturer may like to submit to show the arrangement and merits of the offered equipments, the following drawings shall be furnished:

(i) General installation layout of SMPS equipments showing position of all associated equipments.
(ii) Detailed dimensional drawings and descriptive literatures of all the associated equipments separately.
(iii) Circuit wiring diagram and schematic diagram.
(iv) Literature/ pamphlets/ manuals of SMPS and its associated equipments.

7.0 PACKING & MARKING:

(i) All SMPS equipments shall be packed in strong seasoned wooden crates to avoid handling problem.
(ii) The packing shall be of sufficient strength to withstand rough handling during transit, strong at site and subsequent handling in the field.
(iii) Suitable cushioning, protective padding, or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
(iv) All packing cases shall be marked legibly with the appropriate caution symbol and correctly so as to ensure safe arrival at their destination and avoid dispatched on account of faulty packing and faulty or illegible markings stenciled on it in indelible ink. Whenever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.
(v) Each consignment shall be accompanied by a detailed packing list containing the following information:

a) Name of the consignee.
b) Details of consignment.
c) Destination.
d) Total weight of consignment.
e) Sign showing upper/lower side of the crate.
f) Handling and unpacking instruction.

8.0 GUARANTEE PERIOD:

The guarantee period of each SMPS Battery Charger shall be 24 Months from the date of commissioning or 30 Months from the date of receipt of last consignment at site, whichever is earlier.
TECHNICAL SPECIFICATION FOR PVC INSULATED MULTICORE UN-ARMOURED COPPER CONTROL CABLES

1.0 SCOPE:

The specification covers design, manufacture, testing of all size required cables at the manufacturer’s works of 1100V Grade multi-core, each core containing appropriate number of strands of copper conductor, PVC insulated (Heavy duty) and sheathed un-armoured Copper Control Cables as per sizes specified. Normally, the size of requirement of copper control cables at all pooling stations shall be 18Cx2.5 Sq. mm, 16Cx2.5 Sq. mm, 12Cx2.5 Sq. mm, 10Cx2.5 Sq. mm, 6Cx2.5 Sq. mm, 4Cx2.5 Sq. mm, 3Cx2.5 Sq. mm, 4Cx4 Sq. mm, 4Cx6 Sq. mm etc.

1.1 PVC INSULATED UN-ARMOURED COPPER CONTROL CABLES:

The cables are required for the control and supervision of outdoor/indoors switchgears and power transformers including instrumentation metering, indication and alarm on the control panels and electrical inter-locking between high voltage equipments. With a view to achieve these multifarious requirements, the cables will be laid between individual outdoor equipments and from there to control relay and other allied panels located indoors. The reliability and long life of the control cables is of paramount importance. All the control cables offered against the specification should be suitable for climatic conditions specified in the specification.

2.0 STANDARDS:

2.1 UN-ARMOURED CONTROL CABLES:

1100V Grade multi core, each core containing seven strands of copper conductor, PVC insulated (Heavy duty) and sheathed, Un-armoured copper control cables, shall conform in all respects to the following relevant ISS with latest editions and amendments:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Standard Ref. No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS-1554/Pt.-I)/1988 with latest amendments.</td>
<td>PVC insulated (Heavy duty) Electric Cables for working voltage upto and including 1100 Volts.</td>
</tr>
</tbody>
</table>

3.0 DESIGN CRITERIA:

The Cables shall normally be laid in masonry/RCC trenches whether inside or outside the control room building in groups in tier formation or otherwise, but at some places the cables may be laid direct in ground or in air. The cable may even be laid in vertical formation and in steep gradients at some locations. The cables shall be physically strong to withstand rough installation hazards and thermal/electrical/physical stresses during operation under specified climatic conditions.

4.0 CONSTRUCTIONAL FEATURES:

1100 Volts grade, un-armoured, multi-core, stranded copper conductor, PVC sheathed control cables shall conform to the requirements imposed in IS:1554 (Part-I)/1988 and latest amendments thereto. All the control cables shall bear ISI certification marks as per IS:1554
(Part-I)/1988 with latest amendment. The cables shall have PVC fillers to provide circular cross section before the inner sheath is applied. The fillers should be suitable for operating temp. of the cable compatible with the insulating material.

5.0 COLOUR SCHEME FOR IDENTIFICATION OF CORES:

The individual cores of cable containing two or more cores shall be identified by different colouring of PVC insulation in accordance with IS:1554 (Part-I)/1988 with latest amendment thereto. However, the PVC sheath may be black or grey.

6.0 CURRENT RATINGS:

The current ratings of the control cables shall correspond to the values recommended as per IS:3961 (Part-II)/1967 and its latest amendments.

7.0 INSULATION AND SHEATHING:

The insulation shall be polyvinyl chloride compound conforming to requirement of type A compound of IS:5831/1984. The inner and outer sheathing shall be of polyvinyl chloride compound conforming to requirements of type ST-1 of IS:5831/1984 with latest amendment.

8.0 EMBOSSSING:

To enable identification of control cable the word RSDCL, manufacturer’s name or mark, TN & Year of manufacture, Electric voltage grade, if any and cable size shall be embossed on the outer sheath of cable at the interval of one meter length.

9.0 MARKING:

Every cable drum shall be clearly marked with indelible ink or with suitable weather resistant paint and shall bear the following particulars:

(a) Manufacturer’s name, brand name or trade mark, if any.
(b) ISI certification mark.
(c) Customer’s name
(d) Type of cable and voltage grade
(e) Number of cores
(f) Cable size
(g) Drum number
(h) Purchase order/Tender No.
(i) Gross weight of the drum
(j) Tare weight of the drum
(k) Length of the cable on the drum
(l) Direction of rotation of the drum (by means of an arrow).
(m) Country of manufacture
(n) Year of manufacture

10.0 LATENT DEFECTS ERRORS & OMISSIONS:

10.1 Any cable or part thereof that may develop defects during performance guarantee period shall be promptly replaced by the supplier free of charge.

11.0 TESTS & INSPECTION:
11.1 TYPE TEST:

All Cables shall comply with the requirement of type tests as laid down in IS-1554 (Part-I) 1988 with its latest amendments excluding optional tests. All type tests mentioned in the relevant IS, conducted in a Govt./Govt. approved/ Govt. recognized/ NABL accredited test lab shall be furnished by the contractor/supplier. These test reports should not be older than 7 years as on the date of opening of technical bid for which the date of conducting the test shall be considered. The details of type test are as under:

(a) Test on Conductor:
   (1) Annealing test (if applicable)
   (2) Conductor resistance test.
(b) Tests for thickness of insulation and sheath.
(c) Physical tests for insulation and outer sheath:
   (1) Tensile strength and elongation at break.
   (2) Aging in air oven.
   (3) Shrinkage test.
   (4) Hot deformation.
   (5) Loss of mass in air oven.
   (6) Heat shock test.
   (7) Thermal stability.
(d) Insulation resistance test.
(e) High voltage test (Water immersion test).
(f) High voltage test at room temperature.
(g) Flammability tests:

The purchaser reserves the right to get the material tested in any recognized test house and reject the material, if not found as per specification.

Note: Type test carried out by bidder/supplier in its own R&D unit, even if recognized by Govt., shall not be accepted for its own tender, except in case of Govt. undertaking.

11.2 ROUTINE TESTS:

All routine tests as stipulated in the relevant standards shall be carried out by the supplier on each lot offered for inspection.

11.3 ACCEPTANCE TESTS:

All the acceptance tests as mentioned in relevant IS shall be carried out on samples from a lot for the purpose of acceptance test in presence of purchaser's representative.

11.4 INSPECTION:

(i) The purchaser shall have access at all times to the works and all other places of manufacture, where the material is being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of the material and for conducting necessary tests at any stage.
(ii) The supplier shall keep the purchaser informed in advance about the manufacturing programme so that arrangements could be made for inspection.
(iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
(iv) Inspection & acceptance of any quality of material shall in no way relieve the supplier from the responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such material is later found to be defective.
(v) The purchaser reserves the right to insist for witnessing the acceptance/routine tests of bought out items.
11.5 VERIFICATION OF LENGTH:

The supplier/manufacturer shall provide all adequate facilities at his works for inspection of at least two numbers of cable drums or five percent of the cable drums offered for inspection, whichever is higher, selected at random by the authorized representative of the purchaser for checking/verification of cable length/manufacturing defects by transferring the cable from one drum to another empty drum and at the same time measuring the length of the cable so transferred by means of the meter. The difference in the average length thus obtained from the declared length by the supplier in the packing list shall be applied to all the drums, if the cable is found short during checking the sample lot(s).

12.0 PACKING:

The cables shall be supplied in non-returnable wooden drums with adequate barrel diameter and shall be packed in such a manner that it shall be protected from any kind of damage during transit. Not more than one length shall be wound on one drum. Each end of the cable shall be firmly & properly secured to the drum. The ends of each length shall be sealed before shipment. The supplier shall be responsible for damage, if any on account of defective packing.

13.0 BIS LICENCE CERTIFICATE:

The bidder/supplier shall furnish the attested photocopy of valid BIS License Certificate.

14.0 Overall Guarantee: The cables to be supplied against this contract shall be guaranteed for a period of 12 Months from the date of commissioning or 18 Months from the date of supply at site whichever is earlier.
TECHNICAL SPECIFICATION OF 250 KVA, 33/0.415 KV SUB-STATION TRANSFORMER

1. SCOPE:

This specification covers the design, engineering, manufacture, stage inspection and testing at the manufacturer’s works before dispatch, supply and delivery at the destination stations including loading/unloading anywhere in Rajasthan, of the transformer having ratings as mentioned in this specification. The LT supply from this transformer shall be connected to LT panel (in control room) through twin 3\(\frac{1}{2}\)Cx300 Sq. mm LT power cable.

2. CLIMATIC CONDITIONS: as mentioned in section-1 of this specification.

3. GENERAL REQUIREMENTS:

The intention of the specification is to provide information for the design of the above mentioned transformers to be fully suitable in every respect for the functions designated. It is required that the supplier in accepting the contract agrees to furnish all apparatus, appliance and material whether specifically mentioned or not, but which may be found necessary to complete, perfect, or test any of the herein specified units in compliance with the requirements implied in this specification without extra charges.

3.1 All terminal screws, studs, nuts and bolts shall be in accordance with the Indian Standards.

3.2 All electrical and mechanical equipment shall be designed and manufactured so that no damage will result from transportation, installation and operation of the equipment under the climatic conditions to which it will be subjected.

3.3 All materials used shall conform to this specification and appropriate standards and shall be new in all respects.

3.4 Consideration may be given to alternatives which the supplier considers advisable by reason of his own manufacturing requirements and experiences, provided descriptive matter is submitted and the recommended device or arrangement equal to or superior to that required by the accompanying specification and if the purchaser is convinced of the quality and/or superiority of the equipment.

4. STANDARDS:

The transformers, their accessories and fittings, transformer oil, etc. shall conform to the latest edition of the following standards (as amended upto date) except where specified otherwise in this specification:

1) Transformer : IS:2026 and IS-1180 (Part-1)2014: Outdoor type oil immersed Distribution Transformers upto and including 2500 KVA, 33 KV.

2) Transformer oil. : IEC:60296/ IS1866

3) Bushings. : IS: 2099, 3347, 8603

4) Fittings and accessories : IS:3639 for transformers.


6) Guide for loading of oil : IS:6600
immersed transformers.

7) Method of impulse voltage testing: IS:2070

5. Equipment meeting the requirements of any other authoritative standards which ensures a quality equal to or better than that as per the standards mentioned above, shall also be acceptable. Where the equipment conforms to any other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the bid.

6. DEPARTURE FROM SPECIFICATION:

Should the bidder wish to depart from the specification in any respect, he should draw attention to such departures, stating the reasons there of in the given Schedule. Unless this is done, the departmental specification will hold good. In the event of this specification and contractor's drawings, specification, table etc. being found to disagree during the execution of the contract, the requirement of this specification shall be held as binding unless the departures have been duly approved in writing by the purchaser.

7. TROPICAL TREATMENT:

Under the climatic conditions prevalent at the site, the equipment supplied under the specification will be subjected to operation under the ambient temperature specified under in this specification and very high relative humidity. All equipments shall, therefore be suitably designed and tested for normal life and satisfactory operation under the worst climatic prevalent at the site and shall be dust and vermin proof. All parts and surfaces which are subjected to corrosion shall be made of such material and shall be provided with such protective finishes as would protect the equipment installed from any injurious effects of excessive humidity. All electrical auxiliary equipment shall be specifically tested for tropical conditions and the materials for this treatment shall be as per modern engineering practices.

8. ELECTRICITY RULES:

All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules formed there under and as amended from time to time.

9. TYPE AND RATING:

9.1 The transformers shall be of copper wound 250 KVA, 33/0.415 KV, 3 phase, natural cooled, double wound, core type construction, oil immersed and shall be suitable for outdoor service as step-down transformers (At times however these may be required to work under reversal of power also).

9.2 The tentative requirement of 33/0.415 KV Sub-station Transformers with off circuit tap changer (OCTC) is given in the BoQ.

9.3 These transformers may be required to run in parallel with existing transformers of the similar capacity. The technical particulars of transformers required are as under:

i) Maximum continuous rating at reference ambient temperature specified above : 250 KVA

ii) Frequency : 50 Hz

iii) No. of phases : 3 phase
iv) Rated primary Voltage on principal tap: 33 KV
v) Rated secondary Voltage: 0.415 KV
vi) Winding connections:
   a) HV side: Delta
   b) LV side: Star
   c) Vector group reference: Dyn11
vii) Type of cooling: ONAN
viii) Percentage impedance at normal voltage & 75 deg.C average winding temp. between HV-LV with tolerance as per ISS:
ix) Off circuit tap changer: Having 6 equal step (7 Position of 2.5% each to have voltage variation of +5% to -10% on HV side).
x) Max. current density for HV & LV including tapped winding: 3 Amp/mm sq (for Cu wound)
xii) Neutral unbalance Current: Not exceeding 2.0%
xii) Type of terminal: Vertical takeoff type suitable for ACSR "Panther" conductor on HV sides & suitable for connecting cable thimble 300 sq.mm cable on LV side

9.4 EFFICIENCY:
The percentage loading for the max. efficiency shall be clearly stated in the bid at unity power factor as well as 0.8 p.f.

9.5 INSULATION:
9.5.1 The dielectric strength of the winding, given insulation and the bushings shall conform to the values given in IS:2026 (Part.III)/1981 (or its latest amendment) for highest system voltage of 36 KV, 1.1 KV and shall be suitable for the following impulse test \ power frequency test voltages:

<table>
<thead>
<tr>
<th>SYSTEM VOL.</th>
<th>HST.SYSTEM VOL.</th>
<th>IMPULSE TEST VOL.</th>
<th>PF TEST VOL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 KV</td>
<td>36 KV</td>
<td>170 KVP</td>
<td>70 KV</td>
</tr>
<tr>
<td>0.415 KV</td>
<td>1.1 KV</td>
<td>-</td>
<td>2.5 KV</td>
</tr>
</tbody>
</table>

9.6 TEMPERATURE RISE:
Each transformer shall be capable of operating continuously at their normal rating without exceeding temperature rise limits as specified below:

<table>
<thead>
<tr>
<th>Type of cooling</th>
<th>Temp. rise</th>
<th>External Cooling Medium (Air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONAN</td>
<td>45 °C</td>
<td>When the oil circulation is natural non directed</td>
</tr>
</tbody>
</table>

1. Winding (Temp. rise measured by resistance method)
2. Oil (Temp. rise measured by As above 40 °C -
The maximum ambient temperature for which the transformer shall be designed, shall be 50°C (as per clause 3.02)

The transformer shall be capable of being over loaded in accordance of IS:6600/1972.

Bushing and its terminal connectors shall have minimum continuous current rating corresponding to 120% rated current of transformer at lowest tap.

**9.7. IMPEDANCES:**

The recommended percent impedance at 75°C for 250 KVA shall be 4.50%.

**9.8. GUARANTEES.**

9.8.1 The bidders are required to offer the transformers having no load losses and load losses not exceeding the following values without any positive tolerance.

(i) No load loss at rated voltage, rated current, rated frequency: 450 Watts (Max.)

(ii) Total Loss at 50% load at rated current, rated voltage, rated freq. and 75 Deg.C.: 989 Watts (Max.)

(iii) Total Loss at 100% load at rated current, rated voltage, rated freq. and 75 Deg.C.: 2902.5 Watts (Max.)

The above specified values of losses are maximum guaranteed as per BIS Energy Efficient level-3, without any positive tolerance.

Note:- The BIS-Certificate level-3 rating transformers as per IS-1180 (Part-1) 2014 shall be furnished by the supplier before commencement of supplies. The supplies shall be availed only after furnishing of BIS Certification level-3 by the supplier from Bureau of Indian Standard and any delay in arranging BIS-Certificate for level-3 shall be on supplier’s account.

The bidders quoting losses more than the value prescribed above in the GTP shall be rejected. No benefit shall be allowed to the bidders quoting losses less than the above prescribed values.

The transformer could also be rejected if excess losses are less than above limits but calculations suggest that there is not enough margins in the temp. rise values to be contained within permissible limits to absorb such losses unless temp. rise test is repeated on the transformer free of cost.

9.8.2 The following recoveries shall be made for the excess losses upto the prescribed limits as above:

(i) Recovery for excess of no load losses @ Rs 3,32,000 per KW

(ii) Recovery for excess of load losses @ Rs 1,36,000 per KW.

For fraction of a KW, the recoveries shall be made on pro rata.
The supplier shall provide along with the bid the design details of core assembly showing the construction details, core diameter, nett/ gross sectional area of the core assembly, thickness of lamination etc. The information must also be given in respect of volts per turn at principal tap for normal voltage. The loss curves for type/grade of steel laminations being used for the core shall also be provided along with the bid.

9.9 COOLING:

9.9.1 Each transformer shall be provided with ONAN type cooling as specified under the schedule of requirements.

9.9.2 The ONAN cooling of the transformers shall be by natural circulation of air while the circulation of oil shall be effected by natural convection, the maximum oil flow being assured by a method whereby the return flow of cooled oil is made to enter the tank at a level coinciding with the bottom of the hot columns of oil thus avoiding centre heads of cold oil at the bottom of the tank. Out flow shall be arranged to coincide as nearly as possible with the hot oil level at the top of the tank so that the total available difference will be fully employed in circulating the oil round the shortest possible paths.

9.9.3 The windings of the transformers shall be designed to deliver continuously rated KVA corresponding to ONAN cooling. Radiators shall be provided for cooling purpose. These shall be directly mounted on the tank on both sides in a balanced manner & not on one side only.

9.10 TRANSFORMER CORE:

9.10.1 The core shall be built up with thin lamination of high grade, non ageing, low loss, high permeability, cold rolled, grain oriented silicon steel specially suitable for transformer core. The particulars of laminated steel to be employed/used shall be furnished with the bids along with DC magnetization, B-H and iron loss curves and grade of CRGO Core material indicating nomenclature along with thickness of lamination, specific core loss etc.

9.10.2 If required after being sheared the laminations shall be treated to remove all burrs and shall be reannealed to remove all residual stresses. At least one side of each lamination shall be coated with a double baked enamel insulation coating which will not deteriorate due to pressure and the action of hot oil. The nature of insulation shall be specified in the bid.

9.10.3 Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable, the laminations are flat and the finally assembled core is free from distortion.

9.10.4 The design of the magnetic circuit shall be such as to avoid discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at right angles to the plane of the laminations which may cause local heating.

9.10.5 The core shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibration during operation. The core/clamping bolts shall not pass
through Core/Yoke and clamping structure shall be so constructed that eddy
currents will be minimum.

9.10.6 The core shall be provided with lugs suitable for lifting the complete core and coil
assembly of the transformer. The core and the coil shall be so fixed in tank that
shifting will not occur when the transformer is moved or during a short circuit.

9.10.7 FLUX DENSITY:

The maximum flux density in any part of the core and yoke at rated voltage and
frequency shall be such that the flux density with +12.5% combined voltage and
frequency variation from rated voltage and frequency shall not exceed 1.9 Tesla.
(Note: The design calculations in support of flux density shall be furnished by the
manufacturer).

“No load” current shall not exceed 2% of the full load current and will be
measured by energizing the transformer at rated voltage and frequency. Increase
of 12.5% of rated voltage shall not increase the “No load” current by 5% of the full
load current.

10. WINDING:

10.1 The windings shall be so designed that all coil assemblies of identical voltage
ratings shall be interchangeable and field repairs to the windings can be made
readily, without special equipment. The coils shall be supported between adjacent
sections by insulating spacers and bracers. Bracings and other insulation used in
the assembly of the windings shall be arranged to ensure a free circulation of the
oil and to reduce hot spots in the windings. The windings shall be designed to
reduce to a minimum the out of balance forces in the transformer at all ratios.
The double paper covering insulation shall be used in HV & LV coils.

10.2 The insulation of the coils shall be suitable to develop the full electrical strength
of the windings. All materials used in the insulation and assembly of the windings
shall be insoluble, non catalytic, and chemically inactive in the hot transformer
oil, and shall not soften or otherwise be adversely effected under the operating
conditions.

10.3 All threaded connections shall be provided with locking facilities. All leads from
the windings to the terminal board and bushings shall be rigidly supported to
prevent injury from vibration. Guide tubes shall be used where practicable.

10.4 The windings shall be clamped securely in place so that they will not be displaced
or deformed during short circuits. The assembled core and windings shall be
vacuum dried and suitably impregnated. The Copper conductor used in the coil
structure shall be best suited to the requirements and all permanent current
carrying joints in the windings and the leads shall be welded or braced except
compression type which may be used for terminal connections. Bolted connection
may be used at the bushings and at terminal board with suitable locking device.
The drying out procedure of the core coil assembly shall be indicated in the bid.

10.5 The material used for insulation and coils shall be of best quality and if desired,
invoices and manufacturers test certificates shall be furnished.
10.6 FAULT WITHSTANDING CAPACITY OF WINDINGS:

All the windings shall be suitably designed to withstand short time rating for not less than 2 seconds. The maximum temp. attained for short time rating shall not exceed 250 degree C.

11. INSULATING OIL:

11.1 The oil for first filling shall be supplied with each transformer. The oil shall be EHV grade-I and shall comply IEC: 60296 with latest amendments.

11.2 Particular attention shall be paid to deliver the oil for topping up free from moisture having uniform quality throughout in the non-returnable new steel drums.

11.3 The quantity of oil for first filling of each transformer shall be stated in the bid. Quantity of oil required for filling of conservator and radiators shall be stated in the guaranteed technical particulars.

11.4 The transformer oil purchased from M/s Savita Chemical, M/s Apar, M/s Raj Lubrichem, M/s Raj Petroleum and M/s Lubrichem shall only be supplied. Invoice and test certificates of manufacturer of transformer oil shall have to be furnished as and when desired by the Nigam.

12. TANK:

12.1 The transformer tank and cover shall be fabricated from good commercial grade low carbon steel suitable for welding and of adequate plate thickness. The tank and the cover shall be of welded construction. All seams shall be welded and where practicable they shall be double welded. The transformer tank shall have sufficient strength to withstand without permanent distortion.

12.2 Atleast one manhole/inspection cover with a welded flange and a bolted cover shall be provided on the tank cover. The manhole shall be of a sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

12.3 All bolted connections to the tank shall be fitted with suitable oil tight gaskets which shall give satisfactory service under the operating conditions. Special attention shall be given to the methods of making the hot oil tight joints between the tank and the cover as also between the cover and the bushing and all other outlets to ensure that the joints can be remade satisfactorily and with ease, with the help of semi-skilled labour. Where compressible gaskets are used, steps shall be provided to prevent over compression. Suitable guides shall be provided for positioning the various parts during assembly or dismantling.

12.4 Lifting eyes or lugs shall be provided on all the parts of the transformers requiring independent handling during assembly or dismantling. In addition the transformer tank shall be provided with lifting lugs and bosses properly secured to the sides of the tank, for lifting the transformer either by cranes or by jacks.

12.5 The design of the tank, the lifting lugs and bosses shall be such that the complete transformer assembly filled with oil can be lifted with the use of these lugs
without any damage or distortions. The tank shall be provided with two suitable copper alloy, lugs for the purpose of groundings.

12.6 The exterior of transformer tank shall be thoroughly given one primary coats & two finishing coats of durable oil and weather resistant paints of enamel. The colour of the finishing coats shall be dark admiralty grey confirming to colour code number 320 of IS.

12.7 The plate thickness for tank construction for side plates shall be minimum 5 mm and for top & bottom plates it shall be minimum 6 mm.

13. UNDER CARRIAGE:

13.1 The transformer tank shall be supported on a structural steel base equipped with forged steel or cast steel, flat uni-directional rollers suitable for moving the transformer completely filled with oil.

13.2 Pulling eyes shall be provided to facilitate moving the transformer and they shall be suitably braced in a vertical direction so that bending does not occur when the pull has a vertical component.

13.3 OFF LOAD TAP CHANGER (OCTC) MECHANISM:

13.3.1 The off circuit tap changer shall be of high quality and robust in construction. It shall be located at a convenient position so that it can be operated from ground level by a standing operator. The handle of off-circuit tap changer (OCTC) shall be provided with a locking arrangement. Thus enabling the OCTC to be locked in position. Arrangement for indicating of tap position shall also be provided. It shall be suitable for local manual operations. The tap changer shall be capable of permitting parallel operation with other transformer of the same type.

13.3.2 The OCTC shall be capable of carrying rated MVA on all taps. The breaking capacity of the OCTC shall be compatible with the highest system voltage and current based on maximum over loading permissible under IS:6600 -1972 (150% of rated this) Step voltage of OCTC shall not be less than 115% of 2.5% of the nominal phase voltage of the HV winding and rated through current of OCTC at this voltage will not be less than 150% of rated current of HV winding at lowest tap.

13.3.3 Off circuit tap changing arrangement shall be either by means of an externally operated switch with mechanical blocking device and a position indicator arrangement for pad-locking shall be provided.

13.3.4 OIL PRESERVING SYSTEM:

13.3.4 Oil preserving equipment shall be conventional conservator tank type. The minimum oil level in the conservator tank shall not be below the level of the bushing flanges.

13.3.5 Oil conservator tank shall be located well clear of the bare connection of the transformer terminals. The conservator tank shall have adequate capacity between highest and lowest permissible levels to meet the requirement of
expansion of the total cold oil volume in the transformer and cooling equipment from min. ambient temperature to highest oil temp. as per desired.

13.3.6 The total volume of the conservator shall be min. 10% of the total quantity of oil in transformer.

The inside diameter of the pipe connecting the conservator to the main tank should be 25 to 50 mm and it should be projected into the conservator so that its end is at least 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level corresponding to -50 C should be above the sump level.

14. BUSHINGS:

14.1 All main winding and neutral leads shall be brought out through outdoor type bushings. The electrical characteristics of bushing shall be in accordance with IEC-137 as well as IS-3347/8603 and IS-2099 and IS 7421. The bushing shall be rated for highest voltage and current rating of the respective windings. The current ratings of bushing shall be at least 150% of the rated current at minimum tap to permit overloading. The creapage distance shall not be less than 25 mm per KV.

14.2 The bushings shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electrical clearances between bushings and between the bushings and ground parts. The spacing between the bushings shall be adequate to utilize full flashover strength preventing flashover between the phases or between phase and ground parts under all conditions of operation.

14.3 All bushings shall be equipped with suitable solder less terminals of approved type. The type and size shall be specified in the bid. All external current carrying contact surfaces shall be placed adequately.

14.4 Bushings of identical voltage ratings shall be interchangeable.

14.5 Special adjustable arcing horns shall be provided with HV bushing. Each bushing shall be so co-ordinate with the transformer insulation that all flashover occur outside the tank.

14.6 All porcelain used in bushings shall be of the wet process homogeneous impervious to moisture and free from cavities or other flaws and throughout verified and smoothly glazed. The glazing shall be of the uniform colour and free from blisters, burns and other defects. All bushings shall have puncture strength greater than the dry flashover voltage.

15. CENTRE OF GRAVITY

The center of gravity of the assembled transformer shall be low and as near the vertical center line as possible. The transformer shall be stable with or without oil. If the center of gravity is eccentric relative to track either with or without oil its location shall be shown in the outline drawing.
16. FITTINGS AND ACCESSORIES:

The each transformer shall be provided with the following fittings and accessories:

i) 150 mm dial type thermometer for oil.

ii) One oil drain cum sampling valve for main tank with plug or core plate of suitable size with locking arrangement.

iii) One filter valve located at the top of the tank on the LV side. The opening of this valve shall be baffled to prevent aeration of oil.

iv) One filter valve located near the bottom of the tank on the HV side of the transformer with suitable locking arrangement.

v) Air release device. It shall be of adequate capacity and shall be provided to release the trapped air during/after filling of the oil.

vi) Explosion vent (Pressure release device).

vii) Fixed radiators for cooling as mentioned above.

viii) An oil conservator having detachable end plates, with following provisions:

   a) One oil filling hole with plug and drain valve on the conservator.
   b) One PLAIN oil level gauge having painted/embossed marking as min., normal, and max. oil level.
   c) Silica gel breather with Oil seal and Dehydrating agent.

ix) Eye bolts and lugs on all parts for ease of handling.

x) Two grounding terminals as per clause No.3.20.5.

xi) Rating, Diagram and terminal marking plates:

   Rating, diagram and terminal marking plates of stainless steel or brass for transformers and other accessories giving details as per IS-2026 shall be provided. Purchase order reference, date of dispatch, weight of all important items, no load & load loss figures and postal addresses, Performance guarantee clause 3.34 shall also be indicated.

xii) Bimetallic terminal connectors suitable for "ACSR Tarantulla" for HV bushing and terminals suitable for connecting cable thimble of 300 sq.mm cable on LV side.

xiii) HV bushing with adjustable arcing horns 3 Nos. and 4 Nos. LV bushing

xiv) Triple pole type off load tap changer as per cl.no.3.22

xv) Rollers :

xvi) Transformers shall be provided with Four numbers of flat bi-directional rollers.

xvii) Skids :
xviii) Hauling Eyes: Hauling eyes shall be provided on all the four sides of the transformer base.

xix) Jacking Pads:

Four, sturdy jacking pads shall be provided for lifting complete transformer to enable rotation of its wheels through 90 degree for pulling on transformer tank. Lifting height and safe capacity of jacks shall be specified in Bid.

xx) Lifting Lugs:

Two sets of forged or tested mild steel plate lifting lugs, one set for top cover, core and coil assembly and other set of complete transformer shall be provided. Lifting lugs shall be of adequate strength and size for attaching steel rope slings. Should lugs for lifting complete transformer be located on the base, sling guides shall be provided on cover.

xxi) Inspection Covers:

One inspection covers of sufficient size for access to the interior of the tank shall be provided on the cover. The inspection covers shall be provided with suitable lifting arrangements. All type of valves shall be of gun metal except radiator shut off valves which may be of cast iron/steel. All valves shall be provided either with blind companion flanges or with pipe plugs for protection.

17. FACTORY ASSEMBLY AND TESTS:

17.1 The transformer shall be completely assembled and tested at the Factory. It shall be at the option of the purchaser to send a representative(s) for carrying out stage inspection and various tests during actual manufacture and assembly of transformer(s) so as to satisfy regarding the quality of product and material being used. The meters & instruments used for measurement of losses shall be of accuracy class 0.5 or better.

17.2 All Type and Routine tests as per specification are to be conducted and no deviation in respect of conducting these tests will be acceptable. No extra charges for these tests will be paid. Test charges shall be part of cost of the equipment. Even if charges for such test are indicated elsewhere in the bid, it will be presumed that these tests will be conducted free of cost. If purchaser selects to send a representative, all tests shall be carried out in his presence.

17.3 STAGE INSPECTION:

The supplier shall offer all the transformers for stage inspection.

The stage inspection will particularly include the following tests/ checks besides the general routine tests to be conducted during manufacturing stages as per manufacturer's standard practice. No extra charges for any of the tests shall be quoted / accepted. No deviation shall be acceptable.
i) Physical inspection/checking of winding insulating material, core material and other accessories/ fittings of transformer.

ii) Measurement of core area, cross sectional area of winding(s), number of turns in each winding of one transformer out of the offered lot.

iii) Measurement of thickness of tank plates (Bottom and sides) and to conduct pressure & vacuum tests as per CBIP manual for transformer tests to ensure the adequate strength of tank plates on one tank out of the offered lot. For remaining tanks manufacturer’s test certificates are to be furnished.

iv) Selection of sample of core material from assembled core of one transformer out of the offered lot of transformers and sealing by Inspecting Officer for checking of specific loss at 1.6 tesla, magnetizing characteristics(B-H curve) and thickness from Govt. approved/ Govt. recognized testing lab by supplier. The inspecting officer will measure thickness of core lamination during stage inspection.

The value of specific core loss of core sample taken during core building measured at Govt approved/ recognized lab shall be indicative & for reference purpose only. The transformer shall be considered acceptable as per the provisions of specification based on the losses measured during final inspection/testing.

v) Visual and dimensional check during assembly stage of core.

vi) High voltage test (2KV, 50Hz for one minute) between all core-bolts if provided and agreed to frame bars/fishplates etc. and Ferro-magnetic steel of core.

vii) Check on completed core for measurement of Iron losses.

viii) To carryout the stage inspection, the supplier should intimate the complete schedule of manufacturing programme of these transformers at-least 15 days advance directly to the Superintending Engineer (PROC.II), RVPN, Jaipur.

The production shall not be interrupted in case purchaser’s representative does not reach as per the manufacturing programme to be intimated at least 15 days in advance. However, stage inspection of the transformers to be offered in first lot of minimum four numbers or 25% of ordered quantity whichever is less shall be arranged compulsorily.

Note: The stage inspection of a particular unit shall be considered complete when all the steps stated in the stage inspection are carried out for that particular unit.

17.4 ROUTINE TESTS:

Each completed transformer shall be subjected to following routine tests as per IS:2026 Part-I & III (latest amendment). No extra charges for any of the tests shall be paid. No deviation shall be acceptable. If the supplier desires, he may not fix radiators on transformers (other than the one which is to be type tested) during routine testing. However, in that case, radiator manufacturer’s test certificate shall
be furnished for reference of inspecting officer with undertaking that supplier shall be responsible for proper alignment/fixing of radiator on transformer at site.

a) Measurement of resistance of each winding.

b) Measurement of turns ratio between HV-LV windings at each tap.

c) Checking of polarity and phase relation- ships for each winding.

d) Measurement of no load loss and no load current.

e) Positive phase sequence impedance/short circuit impedance between HV-LV windings on minimum, maximum and normal taps.

f) Separate source voltage withstand test.

g) BDV test on transformer oil as per 3.19.4.

h) Induced over voltage withstand test.

i) Measurement of neutral unbalance current.

j) Regulation at rated load at unity and 0.80 lagging power factor.

k) Load losses measured at rated frequency by applying voltage sufficient to produce the rated relevant current in one winding with the other winding short circuited.

l) Measurement of insulation resistance.

m) The total losses shall comprise of the No Load Losses, load losses at rated output duly converted at 75 degree C average winding temperature and shall also be indicated in the test report. Load losses shall be that corresponding to rated load on HV & LV winding.

n) Routine dielectric tests as per IS:2026 (Part.I & III), 1981.

o) Check complete transformer against approved outline drawing, provision for all fittings, finish oil level etc.

p) **Pressure test**

Plain tanks- The transformer tank with welded/ bolted cover shall be tested at a pressure of 35 kPa above atmosphere pressure maintained inside the tank for 10 minute. There should be no leakage at any point.

q) Oil leakage test

The assembled transformer for non-sealed and sealed type with all fitting including bushing in position shall be tested at a pressure equivalent to twice the normal head measured at a base of the tank for 8 h. There should be no leakage at any point. Tank with corrugations shall be tested for oil leakage test at a pressure of 15 kPa measured at the top of the tank for 6h. There should be no leakage at any point.

r) Tests on transformer oil as per IS:1866-2000 table-1 (Latest amended) Test report from CPRI/ ERDA for oil sample drawn from the tank of transformer
selected at random out of the offered lot of transformers for testing as per table-1 of IS:1866-2000.

17.5 TYPE TESTS:

One transformer (Complete in all respects) selected at random, out of the first lot of minimum two numbers of ordered quantity shall be subjected to the following type tests. No extra charges shall be paid for these tests. Type tested unit shall be guaranteed for satisfactory normal use.

a) Dielectric test: The lightning impulse test along with chopped wave test shall be made in accordance with IS: 2026 (Part.III), 1981 (latest amended) on complete transformer i.e. on all the three limbs of the transformer on HV. The tests on three phases of high voltage winding of transformers shall be performed on extreme tapings and the principal tapping respectively i.e. one terminal will be with minimum tap, other with maximum and third with principal tap position.

b) Temperature rise test: It shall be conducted as per IS:2026/77 Part-II at min. tap (having max. current) by feeding sum of maximum guaranteed No load losses and load losses relevant to min. tap. (having maximum current).

c) Oil leakage test as per CBIP manual.

d) Short circuit test: The successful bidder/contractor is required to furnish detailed short circuit test report as per applicable IS:2026 (as amended from time to time) and as per provision of BIS-1180 (BIS Energy Efficient level-3) of the test conducted at CPRI/ERDA on transformer of similar rating and design as quoted with same guaranteed “NO load” and “Load” losses and percentage impedance at normal tap. The duration of each short circuit shot should be at least 0.25 second. The short circuit test report so furnished shall not be older than 5 (five) years as on the date of technical bid opening.

If facility to conduct impulse test in NABL accredited lab is not available with the transformer manufacturer, then the same shall also be arranged by the supplier at Govt./ Govt. approved/ Govt. recognized laboratory accredited by NABL for the tests conducted at their cost. In that event, the transformer selected at random shall be sealed by purchaser’s representative at firm’s works for sake of identification during above type test. These tests shall also be witnessed by purchaser’s representative at CPRI/ ERDA/ Govt./ Govt. approved / Govt. recognized laboratory accredited by NABL for the tests conducted for which programme indicating date and place of Type tests shall be intimated in advance enabling purchaser to depute his representative. The original preliminary/ provisional test results shall have to be forwarded by testing lab, directly to the purchaser in sealed cover for consideration/ approval of tests as having been satisfactorily withstood by the transformer. Detailed reports shall also be forwarded to purchaser at the earliest. These test reports shall be arranged by the supplier for which no extra charges shall be paid.

If the short circuit test is arranged then no load and load losses shall also be measured at CPRI/ERDA, the losses measured shall be considered as final for
the purpose of calculating penalty for excess losses if any found on higher side.

e) Pressure test:

For non-sealed and sealed type transformers, the transformer tank subjected to air pressure of 80 kPa for 30 min and Vacuum of 500 mm of mercury for 30 min. the permanent deflection of flat plate, after pressure/Vacuum has been released, shall not exceed the values given below.

<table>
<thead>
<tr>
<th>Length of Plate</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 750 mm</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>751 mm to 1250 mm</td>
<td>6.5 mm</td>
</tr>
<tr>
<td>1251 mm to 1750 mm</td>
<td>8.0 mm</td>
</tr>
<tr>
<td>Above 1751 mm</td>
<td>9.0 mm</td>
</tr>
</tbody>
</table>

17.6 The dispatch clearance/ instructions of satisfactorily inspected transformer can be issued subject to withholding 15% cost of transformer, if compliance of any one of or all of the following is not received from supplier:

a) Test report from Govt./Govt. approved/ Govt. recognized lab. for the core material sample of one transformer out of the offered lot of transformers drawn during stage inspection of core building for measurement of specific losses at 1.6 tesla, magnetization characteristics and thickness.

b) Test report from CPRI/ ERDA for oil sample drawn from the tank of transformer selected at random out of the offered lot of transformers for testing as per table-1 of IS:1866-2000.

The above 15% withheld payment shall be made after receipt of satisfactory test reports as above.

17.7 The supplier shall provide the manufacturer’s routine test certificate for bought out items to the Inspecting Officer during inspection.

18. TYPE TEST CERTIFICATE AND BIS-CERTIFICATE WITH BID:

A. The bidder shall furnish the following valid type test(s) reports of Station transformer/ Distribution transformer having similar or higher rating. The type tests conducted at Govt./ Govt. approved lab or manufacturer’s lab at works accredited by NABL for the tests conducted, duly witnessed by Govt. agency or officers of any Electricity Board/Nigam shall be furnished. These type tests certificates should not be older than Five (5) years from the date of opening of bid. Date of test certificate shall be considered as the date on which test was conducted on the equipment.

i) Lightning impulse alongwith chopped wave test as per IS-2026 (Pt.III) latest on complete transformer i.e. on all three limbs of HV of the transformer.

ii) Temperature rise test.
However, if the supplier has manufactured the transformer but is not in a position to arrange the requisite acceptable type test/ short circuit test before commencement of the supply due to non-availability of dates for the testing then pending conducting of type test/ short circuit test on the transformer against RSDCL’s order, 25% (one unit) of the ordered quantity may be accepted subject to furnishing of an undertaking by the contractor to get conducted the temperature rise test on the next unit as per requirement within the stipulated delivery period. However, the payment of 1st unit shall be made after submitting the temperature rise test report.

If the transformer fails in type test/ short circuit test then the supplier shall replace the transformer so supplied by acceptable type tested/ short circuit tested transformer within the contractual delivery period for the total ordered quantity apart from supplying, remaining 75% of transformers of successful type tested and short circuit tested design within contractual delivery period for the total ordered quantity.

If the firm fails to get the type tests & short circuit test conducted successfully before the expiry of contractual delivery schedule for the total ordered quantity and fails to replace the supplied transformer before expiry of the contractual delivery schedule for the total ordered quantity, then the amount so paid along with other claims of the Nigam will be refunded by the supplier to RSDCL. In the event of the failure of the supplier to do the same, RSDCL will be free to recover such amount from financial holds/ Bank guarantees available with RSDCL or in any other manner as deemed fit.

B. The supplier/contractor shall also furnish the BIS-Certificate for level-3 rating as per IS-1180 (Part-1) 2014 from manufacturer of Transformer.

19. TESTS AT SITE: After erection at site, all transformer(s) shall be subjected to the following tests:

   i) Insulation resistance test.
   ii) Ratio and polarity test.
   iii) Dielectric test on oil.

   In case the equipment is not found as per the requirements of the purchase order, all expenses incurred during site testing will be to the bidder’s/ contractor’s account and the material shall be replaced by him at site, free of cost.

20. FURTHER TESTS:

   The purchaser reserves the right of having other reasonable tests carried out at his own expenses either before dispatch or during performance guarantee period from Govt. approved/ Govt. recognized lab. to ensure that the transformer complies with the requirements of this specification after due intimation to the supplier. In case the equipment is not found meeting the requirement of PO/ specification, all expenses incurred for such testing will be on supplier’s account and the material shall be replaced by the supplier at site free of cost.
21. TEST REPORTS:

After all tests have been completed, two certified copies of each test report shall be furnished. Each report shall supply the following information:

i) Complete identification data including serial number of the transformer.
ii) Method of application, where applied duration and interpretation of results for each tests.
iii) Temperature data corrected to 75 degree C including ambient temperature.

22. FREQUENCY AND SYSTEM VOLTAGE:

The transformer shall be suitable for continuous operation with a frequency variation of plus minus 3% from normal frequency of 50 cycles per second without exceeding the specified temperature rise. The highest system rated voltage shall be 36 KV. However, the flux density requirements shall be as per clause 3.16.7.

23. DRAWINGS:

23.1 In the event of an order, the supplier shall submit 3 sets of following drawings /documents as listed below based on final design to the purchaser for approval. The purchaser will review the drawings and return one copy to the contractor:

i) General outline drawings showing front, side elevations and plan views of the transformer and all accessories and external features with detailed dimensions, net and shipping weight, crane lift for undertaking and for erection/ removal of bushing, size of lifting and pulling eyes, HV & LV terminal clearances, live terminal to ground clearances, quantity of insulating oil etc.

ii) Core assembly drawing showing complete constructional details and flux density calculations & details of insulation.

iii) Drawings giving details of name plate & terminal marking and connection diagrams.

iv) Drawings of bimetallic terminal connectors with test certificates.

Thermal/dynamic calculations to prove transformer’s capability to withstand short circuit under worst conditions shall also be provided.

23.2 Each drawing returned by the purchaser will be stamped (a) "Generally Approved" or (b) "Generally approved subject to observation". In case of (b), the inspecting officer shall verify at the time of inspection that care have been taken for the observations.

23.3 Any shop work done prior to approval of the drawing shall be at the supplier’s risk. The supplier shall make all such changes in the design as are considered necessary to make the equipment conform to the provisions and intent of this specification without any additional cost to the purchaser.

23.4 Each drawing shall be identified by a drawings number and each subsequent resubmission/ revision or addition to the drawings or procedure. All drawings shall
be thoroughly checked for accuracy and completeness and signed or initialed by a responsible officer of the contractor.

23.5 Checking and approval of the drawings by the purchaser is for the benefit of the supplier and shall not relieve the supplier of full responsibility for ensuring correct interpretation of design drawings and specifications or for completeness and accuracy of the shop drawings and relevant specifications.

23.6 All drawings shall be in English language and dimensions in metric system.

24. REPAIR GUARANTEE:

The transformer got damaged/ failed during the guarantee period due to manufacturing defects or poor workmanship shall be repaired by the supplier within 45 days period after the date of information to the supplier without any liability on the purchaser. If “TO & FRO” transportation shall be borne by the supplier/ contractor. The repaired transformer shall bear a repair warrantee for further 12 months or a period left out of the original guarantee period whichever is later. Any delay in repair beyond the specified period shall be subjected to penalty as applicable for delay in delivery.

25. IMPORTANT NOTES:

1. The bidder should read the clause No. 3.26 carefully and indicate specifically any deviation in the fittings and accessories as required to be provided on the transformers. In absence of such indication in the bid it will be presumed that all fittings and accessories would be provided as per specification.

2. The Tolerance in weight and Diameter of the transformer shall not be more than (+/-) 5%.

3. Minimum external electrical clearance after mounting the bi-metallic terminal connectors in position shall be maintained as under:

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>MEDIUM</th>
<th>CLEARANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PHASE TO PHASE</td>
</tr>
<tr>
<td>33 KV</td>
<td>AIR</td>
<td>350 mm</td>
</tr>
<tr>
<td>0.4KV</td>
<td>AIR</td>
<td>75 mm</td>
</tr>
</tbody>
</table>

4. Make of each accessories/components shall be clearly and invariably indicated in the GTP/bill of material. Further, following make(s) of bought out items are acceptable to RSDCL:

i) Bushings: - WSI/Modern Insulator (MIL)/ ABIL/ BHEL/ CJI

ii) Bimetallic terminal connector: - Milind Engineering/Vinayak/ Best & Crompton/ Nootan

iii) OFF circuit tap changer: - Alwaye

iv) Oil temperature indicator: - Press & forge/ precimeasure/ ATVUS/ Sukrut Udyog/ Perfect control.
However, other makes of bought out items (except Bushings) are also acceptable, if it is of “ISI mark” or type tested for which bidder shall furnish attested Photostat copy of valid ISI certificate / type test report from Govt. approved/ recognized lab. The type test report should not be older than 7 years as on the date of submission of same.

26. Overall Guarantee period of Transformer:

The complete unit of Transformer including all accessories & fittings, to be supplied against this contract shall be guaranteed for a period of 30 Months from the date of commissioning or 36 Months from the date of supply at site whichever is earlier.
1.0 SCOPE:

This specification covers the design, engineering, manufacture, assembly, inspection and testing at manufacturer’s works before supply and delivery at site of oil immersed, Oil Natural Air Natural (ONAN) cooling, outdoor type, Three Star Rating, 11KV/433V, three phase, 50 Hz, double wound, core type, Aluminium Wound Distribution Transformer of 100 KVA ratings, complete with fittings and accessories for use in Distribution System at Nokh (Jaisalmer).

1.1: The Equipment offered shall be complete with all parts necessary for their effective and trouble free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

1.1.1: It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, not withstanding any anomalies, discrepancies, omissions, incompleteness etc. in these specifications and attached drawings, the design and constructional aspects, including materials and dimensions will be subject to good engineering practice in conformity with the required quality of the product and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulation in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E Act and other statutory provisions.

1.2: The bidder/supplier shall bind himself to abide by these considerations to the entire satisfaction of the RSDCL and will be required to adjust such details at no extra cost to the RSDCL over and above the tendered rates and prices.

1.3: Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian/IEC standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2.0 APPLICABLE STANDARDS:

Unless otherwise modified in the specifications, the Distribution Transformers, including various accessories, shall generally comply with the following Indian Standards/REC Specifications. The standard(s) shall be with latest amendment, if any, from time to time.

Note: Wherever ISS are mentioned, equivalent or better International standards are also acceptable.

(a) IS:1180 (PART-I): Specifications for outdoor type three phase distribution transformers up to and including 100 KVA, 11 KV Class.
(b) IS:2026 (PART-I, II, III, IV & V)/1981: Power Transformers.
(c) IS:6600/1978: Guide for loading of oil immersed Transformers.
(e) IS:3347 (Part-I/Sec. 1 & 2): Dimension of Porcelain parts & Metal parts for Transformer bushing (1.1 KV).
(f) IS:3347 (PART-III/Sec-1&2): Dimensions of Porcelain parts & Metal parts for Transformer bushing (17.5 KV).
(g) IS:7421: Porcelain Transformer Bushings for low voltage – upto 1 KV.
(h) IS:2099/1986: Porcelain Transformer bushing for AC volts above 1000 volts.
(i) IS:3639/1966: Fittings & accessories for Transformers.
Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule.

3.0 PRINCIPAL PARAMETERS:

The Transformers shall be suitable for outdoor installation/service with three phase 50 Hz 11 KV system in which the neutral is effectively earthed & are to be used as step down transformers under fluctuations in supply voltage upto plus 12.5% to minus (-) 12.5% permissible under Indian Electricity Act and Rules there under. The transformer shall confirm to the following specific parameters:

- Continuous rated capacity : 100 KVA
- System Voltage (Max.) : 12 KV
- Rated HT voltage : 11 KV
- Rated LT voltage : 433 V (P-P) / 250 V (P-N)
- Frequency : 50 Hz ± 5%
- No. of phases : THREE
- Primary connection (HT) : DELTA
- Secondary connection (LT) : STAR
- Vector Group : Dyn-11
- Percentage impedance at 75°C : 4.5 %
- Taps (off circuits) : Taps are not required.
- Type of cooling : ONAN
- Fault level of the system : As per site

Primary winding shall be DELTA connected and the secondary winding shall be STAR connected (vector symbol Dyn-11) so as to produce a positive displacement of 30° from the primary to the secondary vectors of the same phase. The neutral of the secondary winding shall be brought out to a separate insulated terminal. The transformers shall be Aluminium Wound.

The transformers shall be designed and constructed to withstand without damage the thermal and dynamic stresses of an external short circuit. The manufacturer/ supplier shall furnish all relevant design data and calculations in support of having fulfilled this requirement as stipulated in IS:2026 (Part-I).

4.0 NO LOAD VOLTAGE RATIO: The No load voltage ratio(s) shall be 11000/ 433 Volts.
5.0 LOSSES:

The max. allowable losses at rated voltage and frequency and at 75 Deg. C shall be as under:

<table>
<thead>
<tr>
<th>RATING (KVA)</th>
<th>Total losses at 75 Deg. C at 50% loading (Max.)</th>
<th>Total losses at 75 Deg. C at 100% loading (Max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>520 watts</td>
<td>1800 watts</td>
</tr>
</tbody>
</table>

The above specified loss values are maximum guaranteed, without any positive tolerance. In case, the actual loss values exceed the above guaranteed values, the transformers shall be rejected at the risk, cost and responsibility of the supplier.

6.0 TEMPERATURE RISE:

Each transformer shall be capable of operating continuously at its normal rating without exceeding following temperature rise with the above service conditions given in clause-3:

(i) 35 Deg. C in oil by thermometer.
(ii) 40 Deg. C in winding by resistance.

Temperature rise test shall be conducted on guaranteed losses.

The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise.

The Hot spot temperature at annual weighted average ambient temperature of 35o C shall not exceed 98o C, when calculated as per IS: 2026 (Part-II). However, the transformer shall be designed for class ‘A’ insulation.

7.0 UNBALANCE CURRENT:

The maximum value of unbalance current in transformers shall not exceed 2% of full load current.

8.0 IMPEDANCE:

The percentage impedance at rated current and at 75°C shall be 4.5% with plus/minus (+/-) 10% tolerance.

9.0 TAPINGS: No taps are to be provided in these transformers.

10.0 FREQUENCY:

Transformers shall be designed for normal frequency of 50 Hz, but shall be capable of giving the rated output with the variation of plus/minus (+/-) 5% from the rated frequency.

11.0 ELECTRICAL CLEARANCES:

(A) EXTERNAL (IN AIR):

Minimum external electrical clearances after mounting the bimetallic Terminal Connectors in position shall be maintained, as under, however, positive tolerance shall be acceptable without any ceiling:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Medium</th>
<th>Clearance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phase to phase</td>
<td>Phase to earth</td>
</tr>
<tr>
<td>11000 Volts</td>
<td>Air</td>
<td>255 mm</td>
<td>140 mm</td>
</tr>
<tr>
<td>433 Volts</td>
<td>Air</td>
<td>75 mm</td>
<td>40 mm</td>
</tr>
</tbody>
</table>
(B) INTERNAL (IN OIL): The following minimum internal clearances shall be maintained as per details given hereunder:

<table>
<thead>
<tr>
<th>PARTICULARS</th>
<th>100 KVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) On width side (non bushing side)</td>
<td>25 mm</td>
</tr>
<tr>
<td>(b) On length side (bushing side HV &amp; LV both)</td>
<td>40 mm</td>
</tr>
<tr>
<td>(c) Between HV windings &amp; yokes (end insulation)</td>
<td>20 mm</td>
</tr>
<tr>
<td>(d) Between LV windings to core (Bare conductor)</td>
<td>3.5 mm</td>
</tr>
<tr>
<td>(e) From top of yoke to inside of top cover of tank (with gasket)</td>
<td>75 mm</td>
</tr>
<tr>
<td>(f) Between LT/HT winding (Radial bare conductor Clearance)</td>
<td>11 mm</td>
</tr>
<tr>
<td>(g) Phase to Phase Clearance between HV limbs</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

The aforesaid external and internal clearances are minimum clearances and no negative tolerance on these clearances shall be allowed.

12.0 TEST VOLTAGE:

Transformers shall be capable of withstanding the following power frequency and impulse test voltages:

<table>
<thead>
<tr>
<th>Nominal system Voltage (RMS)</th>
<th>Highest system voltage (RMS)</th>
<th>Impulse withstand voltage</th>
<th>Power frequency test voltage in (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 KV</td>
<td>12 KV</td>
<td>95 KV (Peak)</td>
<td>28 KV</td>
</tr>
<tr>
<td>0.433 KV</td>
<td>---</td>
<td>---</td>
<td>3 KV</td>
</tr>
</tbody>
</table>

The Transformer shall have fully insulated windings designed for the above impulse level.

13.0 HEAT DISSIPATION (COOLING)/RADIATOR CALCULATIONS & E T R (ELLIPICAL TUBE RADIATORS) PLACEMENT:

The transformers shall be capable of giving a continuous output without exceeding the specified temperature rise. Only Elliptical tube radiators of section 57 of gauge 18 (with tolerance as per relevant ISS) shall be acceptable on the transformers.

The radiator tubes shall be arranged in two equal banks fixed at two opposite non bushing sides. The header pipe connecting radiator bank to the tank shall be rectangular in shape with approximate size of 100 x 20 mm. Alternatively, round pipe of dia 32 mm can also be used for connecting the radiator bank to the tank. The placement of top header pipe to the tank body shall be above the top of yoke, to facilitate cooling for hot oil sump over top yoke.

Cooling area of the tank/radiators should be sufficient to dissipate the guaranteed losses satisfactorily. Necessary calculations in this regard shall be furnished by the Bidder with their offer. For the purpose of heat dissipation calculations, the following criteria shall be adopted:

(i) Plain surface of tank - 500 W/ m²

(Note: The area of top/bottom tank surface, headers, HV/LV bushing pocket and conservator shall not be considered for purpose of above calculations).

(ii) Elliptical tube of section 57 - 55 watts/meter length.

Note: The provision of radiator is essential in distribution transformers to be supplied against this tender.
14.0 WINDING AND INSULATION:

(i) MATERIALS:

Double paper covered aluminium conductors shall be used for 11KV class transformers of
100 KVA rating. The covering shall conform to IS: 6162 (part I & II).

(ii) CONSTRUCTION:

The High-tension windings shall be concentric with the Low-tension windings. The
Arrangement of the windings shall be robust in electrical and mechanical construction
and shall permit free circulation of oil and avoid hot spots. The LT conductor shall be
rectangular in shape. Two layer of electrical grade insulation craft paper of 2 mil thickness
or one layer of min. 4 mil thickness shall be used for interlayer insulation both for HV and
LV Coils. Insulation cylinder made from electric grade pre-compressed board(s) having
minimum total thickness of 1.5 mm shall be used between HV and LV windings. Alternatively
20 mil pressphan paper making thickness of the cylinder 1.5 mm having
similar electrical properties may also be used.

For phase barrier, 2 Nos. of 1 mm thick press board shall be used for covering the tie
rods. Besides, tie rods shall be covered by SRBP tubes of suitable size.

2 mm press board shall be used for base support insulation and core clamping channel
insulation.

For bottom and top yoke insulation, only PC Board of min. 2 mm thickness will be used.

Also, vertical spacers between HV and LV coils and radial spacers (tickleys)/ blocks etc.
shall be of PC Board only.

Top layer of all HV coil shall be given one coat of air dying insulation varnish.

A tolerance of upto plus/minus 1% shall be permissible on ID and OD and axial length of
HV and LV coils. However, the above tolerances are subject to maintaining the min.
required clearances. The material and thickness of various insulation provided for phase
barrier, foot plate insulation, yoke insulation and core clamp insulation shall be clearly
indicated in the drawing and in any case shall not be inferior to those used in type tested
transformers.

Min. number of coils on HV side shall be 4 (four) per phase for 100 KVA rating
transformers. Dovetailed shaped radial spacers shall be placed between HV coil sections,
suitably – locked with vertical spacers around the circumference of the coils. The number
of such spacers shall be minimum 4(four).

CURRENT DENSITY

The current density for HV and LV conductor shall not exceed the value given hereunder:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Current density in Amp/mm sq.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HV winding</td>
</tr>
<tr>
<td>100 KVA</td>
<td>1.6</td>
</tr>
</tbody>
</table>

(iii) INSULATION MATERIAL:

Electrical grade insulating Kraft paper of only Triveni/ Ballarpur/ Padamjee shall be
used. Press Board used shall be of senapathy whitely/ Raman make. Perma wood or
haldu wood blocks shall be used for Top and Bottom yoke insulation.

(iv) CONNECTIONS AND TERMINATIONS:

(A) HV Winding: The following method shall be adopted for taking out HV connections:

(a) The coil series connections shall be made by soldering/ brazing only, after completely removing the insulation from the ends.

(b) Starting and finishing leads of HT coils shall be covered with empire sleeve(s) of proper size. These leads should be clamped with the body of the winding with the help of cotton twine during manufacture of the coils.

(c) All delta leads from the HT coils as well as HT line leads shall be taken out through multiple paper covered (MPC) copper wires of sufficient cross section area to impart the desired mechanical strength. The current density in HV lead wire shall not exceed 0.8 A/mm². These lead wires shall be provided with multi layer paper insulation of minimum 1.0 mm thickness i.e. minimum increase in diameter due to paper insulation shall not be less than 2 mm. The layer of glass sleeves/glass tape shall also be provided on the delta MPC wire and it should be further covered with minimum 12 mm dia SRBP tube. The MPC should also be varnish dipped. The SRBP tube shall be extended in such a way that it is entered upto 50% of bushing height.

(d) All the above leads shall then be clamped tightly with cotton twine directly on to the special frame/bracket making “Pie” shape connection. This structure could be made up of Bakelite/ Permalli wood/ laminated PC board flats, having minimum thickness of 6 mm. Line leads leading to the HV bushing terminals shall be directly clamped to the horizontal support bar of the “Pie” structure so that any tension which may develop in the HT leads due to jerks or at the time of making the connection, is not passed to the HT coils.

(e) Delta joint and lead from delta joint to bushing rod shall be made by brazing only.

(B) LV Winding:

(a) The LV connection shall be taken out by cut on the top yoke channel duly reinforced to compensate for the mechanical strength.

(b) The layers in LT Coil may be either even or odd in numbers but minimum layers shall be two.

(c) LV star point shall be formed of aluminium flat of sufficient strength. Leads from winding shall be connected to the flat by brazing.

(d) Firm connection of LT winding to bushing shall be made of adequate size of “L shape flat”. Connection of LT coils to L shape flat shall be by brazing only.

(e) “L” shape Flat shall be clamped to LV Bushing metal part(s) by using nut, lock nut and washer.

(f) Neutral of the Secondary winding (LV) shall be brought out to a separate insulated bushing.

(g) For Aluminium windings, L&T, ALKAPEE Aluminium brazing rods with suitable flux will be used.

15.0 CORE CONSTRUCTION & CORE COIL ASSEMBLY DETAILS:

(A) CRGO CORE:

(i) The core shall be stack/ wound type of high grade cold rolled grain oriented annealed steel laminations, having low loss and good grain properties, coated with hot oil proof
insulation, bolted together to the frames firmly to prevent vibration or noise. All core clamping bolts shall be effectively insulated. The complete design of core must ensure the permanency of the core losses with continuous working of the transformers. The value of the flux density allowed in the designs and grade of laminations used shall be clearly stated in the offer, along with the curves. The transformer core shall be constructed out of the prime class of materials. CRGO Lamination used shall be of prime grade and not second grade steel laminations.

(ii) It will be mandatory for all the transformer manufacturers to use only PRIME grade CRGO Laminations with specific loss of 0.89 watt per kg. at 1.5 Tesla or any other combination of better grades with any thickness subject to maximum specific loss of 0.89 watt per kg. at 1.5 Tesla will also be acceptable. The bidder shall furnish the core loss (watt/Kg.) and power (VA/Kg) curves of the laminations used. The core shall be properly stress relieved by annealing in inert atmosphere. The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating. The operating flux density shall be such that there is a clear safe margin over the fluxing limit of 12.5%.

(iii) Full mitred core construction technique shall be adopted. Top yoke & bottom yoke pieces shall all be in one single piece and no cut pieces shall be acceptable. The cross sectional area of yoke & limb shall be approximately same.

(iv) The transformer core shall not get saturated for any value of V/f ratio to the extent of 115% of the rated value of V/f ratio (i.e. 11000/50) due to combined effect of voltage and frequency without injurious heating at full load conditions. The bidder shall furnish necessary design data in support of this situation.

(v) Flux density at rated voltage and frequency of core and yoke shall not be more than 1.60 Tesla. The Over fluxing shall be limited to 12.5% of rated value.

The No Load Current (magnetising current) at rated voltage and at 112.5% of rated voltage shall not exceed the values given below:

<table>
<thead>
<tr>
<th>100 KVA</th>
<th>Max. permissible magnetising current in percentage of rated full load current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 100% rated voltage</td>
</tr>
<tr>
<td></td>
<td>3%</td>
</tr>
</tbody>
</table>

The tolerance on magnetizing current shall be +30% on declared value of magnetizing current as per IS: 2026.

(vi) Core clamping:

(a) MS Channel of 100 X 50 mm min. size shall be used on top and bottom (for stacked core transformers).
(b) 2 x 12 mm high tensile bolts to be used in parallel at each end.
(c) Channel on LV side to be reinforced at equidistance, if holes/cutting is done for LT lead in order to avoid bending of channel.
(d) MS channel shall be painted with varnish or oil-resistant paint.
(e) Tie-rods: 4 Nos. of M12 MS steel rods shall be effectively insulated.
(f) All top and bottom yoke nuts & bolts and tie rods shall be painted with oil and corrosion-resistant paint and phosphate coated paint for tie rods before use.
(g) Only prime quality CRGO sheets should be used in the transformers and no second/defective/scrap CRGO finds way into transformers.
(B) AMORPHOUS METAL:

(a) The core shall be high quality amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the flux density allowed in the design shall be clearly stated in the offer. Curve showing the properties of the metal shall be attached with the offer.

(b) Core Clamping – Amorphous Metal and CRGO wound core Transformers.

(1) Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped with MS tie rods for efficient clamping.
(2) MS core clamps shall be painted with varnish or hot oil resistant paint.
(3) Suitable provision shall be made in the bottom core clamp/ bottom plate of the transformer to Arrest movement of the active part.
(c) The transformer core shall be suitable for over fluxing due to combined effect of voltage and frequency upto 12.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation.

(d) Flux density should not be more than 1.6 Tesla for Amorphous core. No load current shall not exceed 3% of full load current and will be measured by energizing the transformer at 433 volts 50 c/s on the secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no load current disproportionately high and shall not exceed i.e., 6%. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of an, bn, cn voltage will be carried out.

NOTE: Equal Weightage shall be given to the transformers with amorphous metal core and CRGO.

(C) CORE-COIL ASSEMBLY:

The core joints shall be interleaved and with full mitre design, as mentioned above. Ample provision for free circulation of oil in the radial gap between the core & LV coils shall be made. Eyes or lugs of sufficient size shall be provided for lifting core and winding assembly out of the tank. The core shall be effectively earthed through tinned copper earthing plate bolted on core frame channels, after removing the channel paint.

For top yoke channels, if cut or holes are made for taking LV connections, suitable reinforcement to channels shall be made by providing adequate size of MS Flat of the thickness not less than 6 mm.

On the core-coil assembly, core clamping channels, tie rods, core studs, spacers, assembly base supports, etc. shall be provided as per details given hereunder:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Item</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Tie rods</td>
<td>Minimum 4 Nos. of 12 mm each properly insulated and covered with SRBP tubes. Tie rods shall also be provided with lock nuts.</td>
</tr>
<tr>
<td>b)</td>
<td>Core studs</td>
<td>Minimum 4 Nos. of 2X12 mm each properly insulated and covered with SRBP tubes. The core studs shall also be provided with lock nuts.</td>
</tr>
<tr>
<td>c)</td>
<td>Spacers</td>
<td>Minimum 4 Nos. dovetail type with min. peripheral coverage of 30%.</td>
</tr>
<tr>
<td>d)</td>
<td>Support of core</td>
<td>2 Nos. MS channels OF 100X50 mm., with minimum peripheral</td>
</tr>
</tbody>
</table>
Guides on all the four sides shall be provided to prevent shifting of the active parts and thereby accidental touching the tank. Alternatively boss nut arrangement at the top of core coil assembly to lock the same with the transformer tank be provided.

The assembly fixing boss nut(s) are to be welded, 20-30 mm off the centre line (and diagonally) of the tanks, so that assembly shifting during transport etc. is prevented. MS Channel, Tie Rods etc should be painted with hot oil and corrosion resistant paint before use.

All core-coil assembly shall be indelibly marked/ punched on core channel/ an identity plate welded on core channel with following details:

1. Name of Supplier  
2. Order/ TN No.  
3. Rating  
4. Sr. No. of Transformer  

In case, if above marking is not found on the core assembly of physically opened transformer selected for physical verification during final inspection then no further inspection shall be carried out and re-inspection charges shall be payable by the supplier.

16.0 TRANSFORMER TANK:

(a) Transformer tank shall be rectangular in shape, robust in construction and with adequate strength to withstand the pressures developed at the time of severe fault conditions. The tank body shall be suitably stiffened to achieve the object. The tank sheet shall be electrically welded both from inside and outside to impart proper mechanical strength and to plug leakage of oil. All joints of tank and fittings shall be oil tight and no bulging shall occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plates shall be of such strength that the complete transformer when filled with oil may be lifted bodily by means of lifting lugs provided. The stiffeners shall be welded full length. All the welding shall be continuous. The top cover plate shall be sloping down by more than 15 mm, opposite LV bushings side. The top cover shall be extended by 5 mm by all the sides beyond the flange of the top cover. Accordingly length of the lifting hooks shall be extended. The top cover shall have no cut at point of lifting lug. No negative tolerance in the tank dimensions is acceptable in actual supply. The tank shall be fabricated by welding at corners. No horizontal or vertical joints in tank side walls and its bottom and top cover will be allowed.

(b) (i) Minimum size of MS Sections to be used in construction of transformer tanks shall be as under:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Items</th>
<th>100 KVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tank Cover plate thickness (mm)</td>
<td>5.0 t</td>
</tr>
<tr>
<td>2</td>
<td>Tank Sides wall thickness (mm)</td>
<td>3.15 t</td>
</tr>
<tr>
<td>3</td>
<td>Tank bottom plate thickness (mm)</td>
<td>5.0 t</td>
</tr>
<tr>
<td>4</td>
<td>Conservator body (mm)</td>
<td>2.0 t</td>
</tr>
<tr>
<td>5</td>
<td>Detachable Conservator side Cover</td>
<td>N.A.</td>
</tr>
<tr>
<td>6</td>
<td>No. of stiffeners (To be welded with one face while the other side of the angle forms inverted “L”)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Size of M. S. stiffener (mm)</td>
<td>40x40x 6 angle</td>
</tr>
<tr>
<td>8</td>
<td>Tank Top flange size (mm)</td>
<td>50 x 6 t Flat</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cover Bolt Size</td>
<td>M10/ 3/8 x 1.5”</td>
</tr>
<tr>
<td>10</td>
<td>Cover Bolt spacings (Maximum)</td>
<td>75 mm</td>
</tr>
<tr>
<td>11</td>
<td>Lifting lugs</td>
<td>2 Nos. 8t mm flat</td>
</tr>
<tr>
<td>12</td>
<td>Tank Base Channel (ISMC Type)</td>
<td>2 (100 x 50 mm)</td>
</tr>
</tbody>
</table>

NOTE: Each cover bolt shall be complete with two flat washers, one nut and one spring washer.

The 12 Nos. Nut Bolts (4 Nos. each on length side and 2 Nos. each on width sides of the tank body) to be tag welded on the top cover/ tank body of the transformer.

The 04 Nos. Anti Theft Fasteners shall be provided - one each on all four sides in centre of body of transformer.

Two holes shall be provided – one on top cover and other on collar of transformer to facilitate providing of 2 Nos. poly-carbonate seals on longitudinal side.

The supplier shall provide additional 8 Nos. stainless steel anti theft fasteners (nuts and bolts) for fixing the base channel on structure.

The above mentioned M S sections shall be subject to tolerance as per ISS.

(ii) MEASUREMENT OF SHEET THICKNESS OF TRANSFORMER TANK

The supplier/manufacturer shall ensure the following measurements of the Transformer & make available the details to the inspecting officer of RSDCL to be visited for inspection and if desired by the inspecting officer, he may check the same during his inspection. The measurements of Transformer Tank Thickness shall be done as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Top Cover</td>
</tr>
<tr>
<td>2</td>
<td>Bottom Cover</td>
</tr>
<tr>
<td>3</td>
<td>Side Wall(s)</td>
</tr>
</tbody>
</table>

(a) The nominal value of sheet thickness will be considered as mentioned in the Specification.
(b) Rolling tolerance will be as per ISS:1852-1985 with latest amendment and no penalty will be charged on such measured thickness till tolerance limit of ISS.
(c) Sheet thickness of transformer tank as per relevant tender specification is as under for ready reference:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Rating</th>
<th>Top Cover</th>
<th>Bottom Cover</th>
<th>Side of Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100 KVA Three Phase</td>
<td>5.0 mm</td>
<td>5.0 mm</td>
<td>3.15 mm</td>
</tr>
</tbody>
</table>

(c) Lifting Lugs: Two Nos. welded heavy duty lifting lugs of MS plate of 8 mm thickness, suitably reinforced by vertical supporting flat welded edge wise below the lug on side wall shall be provided, these shall be so extended that cutting of bent plate is not required

(d) Top cover gasket & Bolt:

(i) The gasket provided in between top cover plate and tank shall be of min. 6 mm thick neoprene rubberized oil resistant cork sheets conforming to type B or C as per IS 4253 part-II.
(ii) G.I. Nut bolts shall be of size M 10 x 40 mm/ 3/8x1.5” long with two flat washers, suitably spaced (as specified) to press the cover.
(iii) Height of the tank shall be such that minimum clear height of 75 mm is achieved between top of yoke and under side of the tank cover (with gasket in place).
(iv) All steel screws, nuts and fasteners exposed to atmosphere shall be either galvanised or cadmium plated or electroplated.

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(v) All sealing washers / gaskets shall be made of oil and heat resistant neoprene or nitrile rubber. Gaskets made of natural rubber sheet are not permissible. The minimum thickness of gaskets shall not be less than 6 mm for tank cover and 4 mm for HT/LT gasket washers.

(vi) New cork/Talbros make neoprene/nitrile based rubberized cork sheet – grade RC-70-C shall only be used as gasket material. Alternatively, other makes of gaskets having type designations as under can also be used, if Talbros’ make gasket is not available:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the firm</th>
<th>Commercial name of gasket manufactured by the firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>M/s. Bharat Corrub Ind., Vadodara</td>
<td>Chetak (Neoprene) RC-70-C</td>
</tr>
<tr>
<td>3.</td>
<td>M/s. Grindbeck, Gujarat</td>
<td>Zebra (Neoprene) RC-70-C</td>
</tr>
</tbody>
</table>

(e) Tank shall be reinforced by continuously welded angle on all the four sides of the walls, on the edge of tank, as specified above. The permanent deflection shall not be more than 5 mm upto 750 mm length and 6.5 mm upto 1250 mm length when transformer tank without oil is subjected to the vacuum of 250 mm of Mercury.

(f) PAINTING & FINISHING:

Steel surface shall be prepared by sand/shot blast or chemical cleaning including phospating as per IS-3618. Heat resistance paint (Hot oil proof) shall be provided inside tank. On external surface, one coat of thermo-setting powder paint or 2 coats of Zinc chromate followed by two coats of olive green colour conforming to Shade No. 220 of IS-5 of 1961 in order to distinguish of star level transformers, shall be applied.

The requirement for paint and the material to be used is as below:

<table>
<thead>
<tr>
<th>Paint Type</th>
<th>Area to be Painted</th>
<th>No. of coats</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Powder Paint</td>
<td>Inside</td>
<td>01</td>
</tr>
<tr>
<td>b) Thermo Setting Powder</td>
<td>Outside</td>
<td>01</td>
</tr>
<tr>
<td>Liquid Paint:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Zinc Chromate (Primer)</td>
<td>Outside</td>
<td>02</td>
</tr>
<tr>
<td>b) Synthetic Enamel (finish coat)</td>
<td>Outside</td>
<td>02</td>
</tr>
<tr>
<td>c) Hot Oil Paint</td>
<td>Inside</td>
<td>01</td>
</tr>
</tbody>
</table>

All steel screws, nuts and fasteners exposed to atmosphere shall be either galvanized or cadmium plated.

(g) The TN No., Sr. No. of the transformer and name of the manufacturer should be punched/embossed on top cover/bottom cover/sides of tank body (size of letter 10x5 mm).

17.0 FITTINGS & ACCESSORIES:

The following standard fittings shall be provided on each transformer:

a) Earthing terminals of M10/ 3/8x1.5” with tinned lugs and symbol – (2 Nos.)
b) Lifting lugs – (2 Nos. for main tank).
c) Rating and terminal marking plate (non-detachable), details to be included in one plate only. The plate shall be of stainless steel only, with details clearly marked - (1 No.)
d) Bi-metallic terminal connectors on HV bushings and it may be ensured that connectors shall be fitted before dispatch.
e) Oil level gauge of minimum 150 mm length of prismatic glass, indicating three positions of oil, marked as follows, shall be provided:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-5 °C - Min.</td>
</tr>
<tr>
<td>2</td>
<td>30 °C - Normal</td>
</tr>
<tr>
<td>3</td>
<td>98 °C - Max.</td>
</tr>
</tbody>
</table>

f) Silica Gel Breather shall be aluminium/ metal – (1 No.)
g) Thermometer pocket, 12.5 mm dia with cap. shall be provided – (1 No.)
h) HV Bushings. These shall be of 17.5 KV/250 A class, with non adjustable, single gap type arcing horns – (3 Nos.)
i) LV Bushings. 1.1 KV class, 250A (M12 stem) – (4 Nos.)
j) Under carriage: For transformers of 100 KVA rating shall conform to REC specifications.
k) Brass rod 12 mm diameter for HT – (3 Nos.)
l) Brass rod 12 mm diameter for LT – (4 Nos.)

Note: LV/ HV Connector shall not be the integral part of the bushing stems.

18.0 **CONSERVATOR:**

When a conservator is fitted, the oil gauge and the breathing device shall be fixed to the conservator. In addition, the cover of the main tank shall be provided with a self-sealing pressure release device designed to operate at minimum pressure of 8 PSI (0.564 Kg./cm. Sq.) to enable release of air trapped within the main tank, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank. The conservator shall be of cylindrical shape and it should be provided above the HV bushing with a minimum clearance of 50 mm and suitably inclined to maintain the clearance.

The total inner volume of conservator shall be minimum 18 Liter for 100 KVA Transformer. The inside diameter of the pipe connecting the conservator to a main tank shall be min. of 30 mm and it should be projected into conservator in such a way that its end is approximately 25 mm above the bottom of conservator so as to create a sump for collection of impurities. The min. oil level (corresponding to -5 deg. C) should be above the sump level. The connecting pipe from conservator tank to main tank shall have a sloping flap so that oil falling from pipe shall not fall directly on the active job.

Apart from the features specified in this clause for conservator tank, the oil filling hole cap of conservator shall be welded with tank body with the help of suitable inverted 'U' shape clamp.

19.0 **SILICAGEL BREATHER:**

Body of breather shall be of aluminium/ metal and inside container for Silica gel shall be of tin sheet. The breather shall be only from reputed and approved manufacturer and as per the approved drawing. The gel capacity shall be of 250 grams. Inverted U shape pipe shall be used for breather. Mounting arrangement of the breather shall be flanged/threaded type as per details given in the illustrative drawing attached.

The design shall be such that the condition of Silica gel is clearly visible from a distance, even after years of service.

20.0 **H V BUSHING TERMINAL DETAILS:**

The transformer shall be provided with outdoor type 3 Nos. 17.5 KV/250 A Class porcelain bushings, conforming to IS:3347/1972 & IS:2099/1973 from the reputable manufacturer. The LV/ HV bushings shall be on the opposite side of the tank. The bushing on the top cover of the
transformer shall not be acceptable. The bushings rods and nuts shall be made of brass. The HV bushing shall be fitted on a conical pocket (full length tank) on the tank body and not directly on the pipe/ flange. However, small pieces of pipe may be mounted on conical pocket for maintaining electrical clearance if required. The inner porcelain portion of the bushing shall be projected about 50% of the length inside the conical pocket. HT bushing(s) mounting bolts should be tag welded.

The clamping ring of HV bushing shall be of galvanised MS Sheet having minimum thickness of 1.6 mm. The total weight of all the 12 aluminium caste member of HV bushing shall not be less than 210 grams.

The arcing horn(s) shall be single gap and fixed type. HV bushings shall be of reputed make such as BEPCO, JAYSHREE, WSI, SESHASAYEE, JAIPUR GLASS, BPPL Bikaner, Agarwal salt Co., Bikaner, Bais Sanitary Works, Bikaner/KRISHNA CERAMICS, NASIRABAD or any other make approved by the RSDCL. The HV bushings shall generally conform to IS: 3347 and IS: 2099. Embossing showing the manufacturer’s name and month & year of manufacture shall be clearly visible on HV bushings, even after fixing on transformer.

As mentioned earlier, suitable bi-metallic connectors shall be provided, forming an integral part of the bushing stem, having capacity of about 1.5 times the rated current of the transformer.

21.0 LV BUSHING TERMINAL DETAILS:

LV Bushing side shall be opposite to the HV Bushing side. 4 Nos. LV Bushings (1.1 KV/ 250 A) shall be mounted on a special pocket on the tank wall. Projection of the LV pocket shall be such that inner portion of the LV stem shall not project more than 20 mm inside the tank, to facilitate unhindered lifting of the core coil assembly. Bushing stem of M12 size shall be of brass. Rest of the components shall conform to the requirement of IS: 3347 (Part I/section 2). The LV bushings shall be of reputed make such as JSI, JAIPUR GLASS, BPPL Bikaner, Baid Sanitary Works, Bikaner, Agarwal salt Co. Bikaner, or any other make approved by the RSDCL. The LV bushings shall generally conform to IS: 3347 and IS: 7421.

22.0 TRANSFORMER OIL:

The transformer shall be supplied complete with first filling of EHV Grade transformer oil, up to the normal oil level. The oil shall conform to IS: 335-1993 (latest amended) and should be ISI marked and having the specified aging characteristics.

The make of Transformer Oil shall be APAR/SAVITA/RAJ LUBRICANTS/ANAMIKA/ SHARAVATI/ MADRASPETRO/ RAJPETROL/ LUBRICHEM, MUMBAI/ OPANAMA PETROCHEM, NKELSHWAR/ TASHKENT OIL, VADODARA/COLUMBIA. The transformer oil sample taken from the transformer shall be subject to testing as per provisions of IS: 1866.

The oil manufacturer's test certificate shall be made available at the time of inspection to the inspecting officer.

23.0 IDENTIFICATION DETAILS:

(a) Rating & terminal marking plate: Transformer shall be provided with non detachable name, rating and terminal marking plate fitted in a visible position. All details shall be given on one plate. Material of the plate shall be stainless steel only. Thickness shall be 0.9 mm (with a tolerance of ±0.1 mm). The plate shall be made absolutely undetectable either through welding or riveting or through any other approved method.

Each HV & LV terminal shall be duly marked with its terminal numbers (i.e. HV terminal with capital letters 1U, 1V, 1W and LV terminal by corresponding small letters 2u, 2v, 2w and the neutral terminal by 2n). In the diagram to be given on the name plate, the relative
position of various terminals, when viewed from top shall be clearly shown. Inspection shall not be undertaken unless all these details are verified by the Inspecting Officer.

Besides other particulars, following details shall also be given on the name plate:

(i) PO No. - Month & Year.
(ii) Sr. No. of transformer.
(iii) Date of despatch - Month & Year.
(iv) Date of expiry of guarantee period - Month & Year.
(v) Maximum Guaranteed No Load & Load Loss Figures.
(vi) Recommended fuse sizes for HV & LV sides.
(vii) Name & Full address of the manufacturer.
(viii) Capacity of the transformer.
(ix) Rating of the transformer.
(x) Type - Oil filled naturally cooled.

All details on the name rating and diagram plate shall be indelibly marked i.e. by engraving, stamping or punching.

(b) Identity Plate: A M.S. plate of size 75 x 75 x 2.5 mm shall be continuously welded to the main tank body below the middle HV bushing and in clearly visible position, with following details clearly punched:

RSDCL TN –
.......... KVA, S. NO. ..........
..........MAKE .................

(c) Identification Mark: In addition to above, the following identifying details shall be clearly punched on top cover near lifting lug, towards neutral side, with minimum 8 mm x 6 mm size punch letters:

MAKE _________
Sr. No. _________
TN _________

The above identification mark shall also be punched/welded to one of the top core clamping channels.

Further, the following details are to be punched on all sides of the tank preferably in center. The dimensions of letters should be 10x10x1 mm. The punching shall be distinct and visible.

(a) Make
(b) TN No.
(c) Sr. No.

(d) Technical Plate- In addition to existing provision of identity plate and name plate one plate also be affixed on the transformer mentioning the following details:-

(A) Name of the Firm
(B) TN No.
(C) Make
(D) Rating
(E) Core : 1. Core Dia
2. Core Area
(F) LV Coil:
1. ID/OD Dimensions
2. Conductor Size
24.0 GUARANTEED AND OTHER TECHNICAL PARTICULARS FOR TRANSFORMER:

Guaranteed Technical particulars of the transformers offered shall be furnished by the bidder. Complete details of the Transformer shall be furnished. Tolerances on weight quantity and dimension figures shall be ± 5% (except for internal configuration) at the tender stage, subject to maintaining the minimum electrical clearances as per the specification. However, no negative tolerance shall be allowed on the Short Circuit type tested design. Electrical performance data shall be subject to tolerances as per ISS, unless otherwise specified in this specification. However, the No Load loss and Load loss figures shall be maximum guaranteed without any positive tolerance.

25.0 TYPE TEST CERTIFICATES:

In case of order, the successful bidder shall furnish type test certificates of similar rating & design submitted for BEE labelling (not older than 7 years).

26.0 DRAWINGS AND OTHER DOCUMENTS:

In case of order, the successful bidder shall furnish the following drawings/calculation sheets as per the offered design. The drawings shall be only on A-3 (420 x 297 mm) size paper and calculation sheet shall be on A-4 size paper only:

(a) Name rating/diagram plate drawing.
(b) Outline and general arrangement drawing.
(c) Core-coil assembly drawing.
(d) Core section (for limb and yoke) along with flux density calculation sheet/drawing.
(e) Cooling area calculation sheet.
(f) Thermal Ability Short Circuit calculation sheet.
(g) Core loss and magnetization curves of the laminations.
(h) Heat dissipation calculations (heat dissipation by tank walls excluding top and bottom should be 500 W/sq. meter).

27.0 INSPECTION AND TESTING:

(i) The inspection and testing shall be conducted as per relevant clause of the General Conditions of Contract at the works of manufacture. The transformer shall be completely assembled and tested at the factory. The inspection may be carried out by the RSDCL at any stage of manufacturing. The supplier shall grant free access to the RSDCL's representative at all reasonable times when the manufacturing work is in progress. Inspection and testing of any material under this specification by the RSDCL shall not relieve the supplier/manufacturer of his obligation of supplying the material in accordance with the specification and shall not prevent subsequent rejection, if the material is found to be defective.

(ii) The supplier shall make available the inspector of the RSDCL all reasonable facilities, without charge, to satisfy him that the material is being manufactured in accordance with the specification. The bidders must have adequate set of instruments for conducting testing as per ISS/Specification. The instruments for measurement of losses shall be of accuracy class of 0.5 or better. The instruments shall be duly calibrated and Calibration Certificate should not be older than one year on the date of presentation to the Inspecting Officer. The calibration shall be arranged from manufacturer or NABL accredited testing lab.
calibrated instruments shall be duly sealed by calibrating agency to avoid any tampering with calibration and the details thereof shall be clearly mentioned in the Calibration Certificate(s).

(iii) The supplier shall keep the RSDCL informed in advance, about the manufacturing programme so that arrangements can be made for inspection. The supplier shall give minimum fifteen days advance intimation to enable RSDCL to depute his authorised representative for inspection/ witnessing of various tests on the equipment/ material as detailed below:

NOTE: Penal provision shall be made for any short technical parameters found/ noticed in the transformers at any time even beyond guarantee period.

28.0 ROUTINE/ ACCEPTANCE TESTS:

(A) All the Transformers shall be subjected to acceptance tests at manufacturer’s works for measurement of total load losses at 50% & 100 % loading and other testing as per provisions.

(B) All the assembled/finished transformers prior to despatch shall be subjected to routine tests as per IS:2026. The supplier shall invariably furnish manufacturer’s routine test certificate along with inspection call of the offered transformers for pre-despatch inspection.

The Transformer shall be subjected to the following routine/acceptance tests at the manufacturer’s works in accordance with the relevant ISS:

1. Insulation resistance.
2. Separate source voltage withstand test.
3. Induced over voltage withstand test.
4. Measurement of windings resistance cold (at or near the test bed temperature).
6. Measurement of Impedance voltage and load losses at rated current and normal frequency.
7. Measurement of total losses at rated voltage and normal frequency (at 50% & 100% loading).
8. Measurement of No load current at 100 % and 112.5% of rated voltage and normal frequency.
9. Checking of rating and terminal marking plate.
10. Checking of weights, dimensions, fittings and accessories, tank sheet thickness, oil quantity, material, finish, paint thickness and workmanship as per purchase order and contract drawings.
11. Physical verification of core – coil dimension, internal clearances, provisions of required oil ducts in the HV and LV winding, conductor sizes, individual weights of HV and LV winding core laminations etc., with reference to contract drawings and type test report(s) by dismantling selected unit(s). The physical verification shall be conducted on units equivalent to one unit per 50 Nos or part thereof of offered quantity randomly selected from the offered lot. The dismantled unit(s) after re-assembly shall be accepted by the purchaser after routine testing in presence of his representative.

During final inspection, sheet thickness shall also be measured of the transformer opened for physical verification. The instrument for measurement of sheet thickness will be provided by the supplier.

12. Oil dielectric strength (break down voltage) test shall be carried out on the transformers opened for physical verification and average value shall be calculated.
13. Checking of manufacturer’s test certificates and invoices for major raw materials shall be done and copies thereof duly signed by firm’s representatives and inspecting officers shall be enclosed with the inspection report.

Invoices of CRGO/ AMORPHOUS material shall be provided by the supplier to the inspecting officer at the time of inspection and same shall be verified by the inspecting officer.

The following tests shall also be carried out at manufacturer’s works on one complete unit of 100 KVA Transformer:

(i) Air pressure test on empty tank of transformer opened for physical verification test. (See note below)
(ii) Over Flux Density Test (in the first lot and may be repeated in subsequent lots if desired by purchaser).
(iii) Measurement of unbalance current.
(iv) Magnetic Balance Test (See note below).
(v) Oil Leakage Test (See note below).

Fifteen days clear notice shall be given for pre-despatch inspection by RSDCL’s representative as per General Conditions of Contract.

After successful inspection, the inspecting officer shall seal the transformer with 2 Nos. poly-carbonate seals on longitudinal side as per the manner mentioned in Clause No. 27 above. Before sealing, the inspecting officer will ensure that the offered transformer is complete and duly fitted with name, rating and diagram plate, identification plate (on tank body & Top cover) as specified in this specification.

Also after inspection/testing, the inspecting officer shall affix Signature Seals also on Transformer in addition to other seals.

(i) INSULATION RESISTANCE MEASUREMENT:

Insulation resistance of selected samples shall be measured with a 2500V Megger, of standard make such as M/s AVO, M/s Sakova, M/s Wako, M/s Evershed, Vignole or Metrawatt. The minimum insulation resistance in Mega Ohms shall be as indicated in the table below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11000 Volts (HV)</td>
<td>800</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>433 Volts (LV)</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>50</td>
<td>25</td>
</tr>
</tbody>
</table>

(ii) AIR PRESSURE TEST:

This test shall be conducted as type test at the time of inspection of Transformer, at the manufacturer’s works. The pressure gauge and vacuum gauge shall be duly calibrated and sealed by an independent recognised test lab(s).

The test procedure shall be as detailed below:

The tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subjected to air pressure of 0.8 Kg./ cm² (gauge pressure), for 30 minutes.

Permanent deflection of flat plate, after pressure has been released, shall not exceed the values given below:
<table>
<thead>
<tr>
<th>Length of plate up to</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 mm</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>751 to 1250 mm</td>
<td>6.5 mm</td>
</tr>
</tbody>
</table>

(iii) MAGNETIC BALANCE TEST:

This test shall be conducted as an additional test on transformer from offered for inspection.

The application of low voltage to the middle limb will induce approximately equal voltages on the two end limbs. The application of voltage to the end limbs will induce greater voltage in the middle limb and less voltage in the other end limb. Uniformity of induced voltages shall confirm the healthiness of the transformer windings.

The procedure for the test shall be as under:

(a) Apply 250 Volts between LV terminals-2u-2n and measure voltages between 2v-2n & 2w-2n.
(b) Apply 250 Volts between 2v-2n and measure voltages between 2u-2n & 2w-2n.
(c) Apply 250 Volts between 2w-2n and measure voltages between 2u-2n & 2v-2n.

The measured voltages shall satisfy the conditions detailed as above.

(iv) OIL LEAKAGE TEST:

The oil leakage test shall be conducted on the Transformer offered for inspection. Transformer complete in all respects shall be subjected to the pressure corresponding to 0.5 Kg/cm² and maintained for three hours. No leakage should occur.

29.0 TYPE TESTS:

The firm shall furnish complete type test reports of this rating transformer (submitted for BEE labeling) for verification and checking along with drawings for approval.

30.0 Overall Guarantee period of Transformer: The complete unit of Transformer including all accessories & fittings, to be supplied against this contract shall be guaranteed for a period of 30 Months from the date of commissioning or 36 Months from the date of supply at site whichever is earlier.
**PRINCIPAL PARAMETERS OF PLCC EQUIPMENTS**

1.0 WAVE TRAP:

(i) Wave traps shall be inserted in series with the high voltage transmission lines to prevent undue loss of high frequency carrier signal for all power system conditions. Its impedance shall be negligible at power frequency (50 C/s) so as not to disturb the power transmission, but must be relatively high over any frequency band appropriate to carrier transmission i.e. 50 KC/s to 500 KC/s.

(ii) Line trap shall consists of a single phase, air cored inductor of dry type with natural air cooled, main coil designed to carry continuously the rated power frequency current at the max. ambient temperature. It shall be supplemented with a protective and tuning device. It should meet the requirements of IS-8792-1978 with latest amendments.

(iii) Line traps are to be tuned for a carrier frequency band which will depend upon the operational carrier frequency pair chosen for transmission line section in question. The relative component of impedance of the line trap within its band width shall not be less than 570 Ohms. The tuning device shall be arranged to permit inter-change without removing the line trap.

(iv) Line trap shall be provided with a protective device which shall be so designed and arranged such that neither significant alteration in its protective function nor physical damage shall result from either the temperature rise or from the magnetic field of the main coil at continuous rated current or rated short time current. The protective device shall neither enter into operation nor remain in operation following transient actuation, at the power freq. voltage developed across the line trap by the rated short time current.

(v) The protective device shall be a non linear resistor type arrester complying with the requirements of latest issue of IS-3070(Part-I)-1974 and shall be shunt connected to the main coil and the tuning device for proper coordination with the lightning arrestors installed in the sub-stations, the line traps shall be provided with protective device with nominal discharge current of 10 KA.

(vi) The line traps (for 220kV lines) should be suitable for outdoor pedestal mounting and mechanically strong to withstand the stresses due to max. wind pressure of 195 KG/cm2. Necessary mounting arrangement for the wave traps shall be provided by the Contractor.

(vii) Line traps shall confirm to following technical particulars:

<table>
<thead>
<tr>
<th>Nominal system voltage</th>
<th>220 KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Max. system voltage (KV) on which line traps are to be used</td>
<td>245</td>
</tr>
<tr>
<td>(b) Rated continuous current (Amps).</td>
<td>1250/2000</td>
</tr>
<tr>
<td>(c) Rated short time current duration 1 sec. (KA)</td>
<td>40</td>
</tr>
<tr>
<td>(d) Asymmetrical peak value of the first half wave of rated short time current (KA peak)</td>
<td>102</td>
</tr>
<tr>
<td>(e) Minimum resistive components of impedance within the band width (Ohm).</td>
<td>570</td>
</tr>
<tr>
<td>(f) Nominal discharge current of protective device (KA)</td>
<td>10</td>
</tr>
<tr>
<td>(g) Inductance of main coil (mH)</td>
<td>0.5</td>
</tr>
<tr>
<td>(h) Max. tapping loss (dB)</td>
<td>2.6</td>
</tr>
<tr>
<td>(i) Attenuation at Tuned frequency (dB)</td>
<td>8.0</td>
</tr>
<tr>
<td>(j) Blocking band details (KHz)</td>
<td>150-500</td>
</tr>
<tr>
<td>(k) Line characteristic impedance (Ohm) (Phase to earth for single conductor line)</td>
<td>400</td>
</tr>
</tbody>
</table>
TYPE TESTS FOR LINE/WAVE TRAPS:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Test</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature rise test</td>
<td>IEC:353, Clause 19.1</td>
</tr>
<tr>
<td>2</td>
<td>(Corona extraction voltage Test)</td>
<td>IEC:353, Clause 19.2</td>
</tr>
<tr>
<td>3</td>
<td>Impulse voltage withstand test</td>
<td>IEC:353, Clause 19.3.1</td>
</tr>
<tr>
<td>4</td>
<td>Power frequency voltage test on tuning device</td>
<td>IEC:353, Clause 19.3.2</td>
</tr>
<tr>
<td>5</td>
<td>Short time current withstand test</td>
<td>IEC:353, Clause 19.4</td>
</tr>
<tr>
<td>6</td>
<td>Measurement of the rated inductance of the main coil</td>
<td>IEC:353, Clause 19.5</td>
</tr>
<tr>
<td>7</td>
<td>Measurement of power frequency inductance of the main coil</td>
<td>IEC:353, Clause 19.6</td>
</tr>
<tr>
<td>8</td>
<td>Measurement of blocking resistance and blocking impedance</td>
<td>IEC:353, Clause 19.7</td>
</tr>
<tr>
<td>9</td>
<td>Measurement of tapping loss &amp; tapping loss based on blocking resistance</td>
<td>IEC:353, Clause 19.8</td>
</tr>
<tr>
<td>10</td>
<td>RIV Measurement</td>
<td></td>
</tr>
</tbody>
</table>

2.0 COUPLING DEVICES: (Phase to Phase):

2.1 Coupling Devices for power line carrier circuits are devices interposed between the coupling capacitors and PLC transmitter/receiver and shall be designed to:

(a) To assure efficient transmission of carriers frequency signals between the carrier frequency connection and the power line and vice versa.
(b) For safety of personnel and to protect the low voltage part of the installation against the effects of Power frequency voltage and transient over voltages.

(i) COUPLING FILTER:

Coupling filter in conjunction with the capacitance of the coupling capacitor shall constitute an electric filter of band pass type. It shall match the characteristic impedance of the high tension line with impedance of the connecting PLC transmitter/ receiver. The phase to earth characteristic impedance of the high tension line may be assumed to be 400 Ohms.

The coupling device shall be so designed that the impedance at power freq. between the primary terminal and the earth terminal is as low as possible and in no case in excess of 20 Ohms. This low impedance shall be ensured by a device such as a drain coil or matching transformer.

(ii) DRAINAGE OF CHARGING CURRENT:

The primary of the coupling unit shall have low impedance for the operating freq. of the power line (50 Hz) so that charging current of the coupling capacitor is grounded. The drain coil winding shall:

(a) Offer a max. Guarantee of continuity of connection to the earth terminal.
(b) With-stand any over voltage which may occur on the power line, taking into account the effect of the main arrestors.
(c) Insulation.

(iii) EARTHING SWITCH:

(a) An earthing switch shall be provided for making a temporary direct connection between the primary and earth terminals. The method of operating the earthing
switch shall take due regard of requirements of safety with the I.E. Rules. In case earthing switch is enclosed, an indication of ‘ON’ & ‘OFF’ position of it be clearly visible.

(b) MAIN ARRESTOR:

A lightning arrester shall be connected as directly as possible between the primary and earth terminals and shall be capable of protecting the coupling device and the carrier freq. connection. The lightning arrester shall be of non-linear resistor type and should meet the requirements of IS-3070 (Part-I)-1974 with latest amendments.

(c) The input and output circuits of the coupling units shall introduce a galvanic insulation into a coupling unit and should be able to withstand a test voltage of atleast 10 KV for 1 minute.

2.3 The coupling units should be housed in an insulated fiber glass reinforced polyester enclosure to make it weather proof and trivialized corrosion free or suitable for installation on the steel pedestal structure used for mounting coupling capacitors/CVT.

2.4 The coupling unit shall be provided with the lightning arrestors as above, to protect the carrier equipment against excess voltage which may occur when the coupling capacitor becomes defective or the ground load connected to the coupling unit is interrupted.

2.5 The coupling unit shall confirm to the following carrier freq. operating characteristics:

| (a) | Primary impedance | 640 Ohms, for Phase to Phase coupling. |
| (b) | Secondary impedance | 75/125 Ohms for un-balance secondary circuit. 150 ohms balanced secondary circuit. |
| (c) | Max. composite loss | 2 dB. |
| (d) | Transmission band | 50 to 500 KHz. |
| (e) | Earthing switch rating | 400 A |
| (f) | Drainage coil: | |
| (i) | Continuous current | 1A |
| (ii) | Short time current | 50A for 0.2s |
| (iii) | Inductance | <= 63.6 mH. |
| (g) | Lightning arrester: | |
| (i) | Rated voltage | 1 KV |
| (ii) | Impulse spark over voltage | 4 KV |
| (iii) | Discharge current | 10 KA |
| (h) | Nominal Peak Envelop Power | 600 W upto 1000W at 100KHz |

TYPE TESTS FOR COUPLING DEVICES:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Test</th>
<th>Reference of IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Impulse voltage withstand test.</td>
<td>8998-1978, Clause 3.5. IEC:481, Clause 12.4</td>
</tr>
</tbody>
</table>
2.6  75 Ohm (Unbalanced) H.F. Coaxial Cable with Polyethylene (Semi-solid, Air-spaced) insulation.

2.6.1  The H.F. Coaxial cable shall be offered to connect coupling unit installed in the switch yard to the PLC terminal installed indoor. The H.F. Cable to be offered shall be suitable for being laid directly on the ground or in trenches or in ducts without being deformed. The cable shall be braided tinned copper and galvanized steel wire.

2.6.2  The capacitance of the cable shall be low so as to minimise attenuation at the carrier frequency range, the impedance of the cable shall be so as to match with the output impedance of PLC terminals and secondary impedance of the coupling units.

2.6.3  The H.F. Coaxial Cable having impedance of 75 Ohms unbalanced with solid hard drawn copper wire as central conductor, air space dielectric by means of a composite helical thread of polyethylene in a polyethylene tube and tinned copper braid, PVC sheath black, Non Hygroscopic layer, galvanized steel wire braid and outer PVC sheath of blue colour, generally confirming to BSS-2316 and IS:11967 (Part-2, Sec.1) 1989 with latest amendments.

2.6.4  Essential Requirement: The 75 Ohms (unbalance) High frequency Coaxial Cable with Polyethylene (semi solid Air spaced) Insulation shall confirm to type R 75-5-B 100 in accordance with IS:11967 (Part-2/Sec.- II)-1989 or latest amendment thereof and IS:5026-1987 General requirement and tests for H.F. Cables or latest amendment thereof.

3.0  POWER LINE CARRIER COMMUNICATION TERMINALS:

3.1  SCOPE:

(a) The PLCC equipment shall be suitable for transmission of speech, data, protection signal superimposed & fax message etc. The PLC terminals shall use amplitude modulation with suppressed carrier, single side band, multipurpose, 4 KHz and shall be site programmable for audio frequency, carrier frequency, pilot frequency and transit band pass filters. The equipment shall be suitable for duplex working and shall use the latest technology using Digital signal Processor. The PLC terminal shall have remote subscriber facility and loop testing facilities.

(b) The PLC terminal shall have common AF bus so that protection coupler, VFT equipment can be inserted in reserve slots of PLC terminal in future without any necessity of wiring or any intermediate unit.

3.1(A) The PLCC terminals shall confirm to the following electrical characteristics. These characteristics referred to single side band PLCC terminals:

(1) Mode of transmission : Single side band with suppressed carrier.
(2) High frequency range. : 50 KHz to 500 KHz site programmable.
(3) Nominal carrier frequency band : 4 KHz
(4) Effectively transmitted speech freq. band : 300 to 2000 Hz.
(5) Effectively transmitted signal freq. band for transmission of data, carrier protection and for other signals : Suitable for transmitting data at a data signalling rate of 50,200,300,600,1200 baud as per CCITT standards
(6) Nominal Impedance:
  (a) Carrier freq. side : The nominal impedance at the frequency output shall be 75 Ohms or 125 Ohms (unbalanced) or 150 Ohms (balanced).
  (b) Voice freq. side : The speech & signal output circuits shall be balanced & have a nominal impedance of 600 Ohms.
(7) Nominal carrier freq. : 40 Watts (programmable from 20w to 40w) power. The above power should be peak envelope power available at the line output terminals at a resistive load equal to the nominal load impedance for single tone keying. Bidder should furnish justification if higher/lower power is recommended.

(8) Stability of carrier freq. from its nominal value. : ± 5 Hz.

(9) Relative levels (VF side):
   (a) 4-wire transmit : 0 dB to - 17 dB.
   (b) 4-wire receive : 3.5 dB to + 8 dB.
   (c) 2-wire transmit : 0 dB.
   (d) 2-wire receive : -7 dB.

(10) Level regulation (Automatic gain control). : Automatic gain control shall be provided so that AF output should remain constant within ± 0.5 dB for a +14/-26 dB variations in the RF input level.

(11) Return loss:
   (a) The return loss within the nominal carrier frequency band in the transmit direction shall not be less than 12 dB.
   (b) The return loss within the effectively transmitted frequency band shall not be less than 12 dB.

(12) Telephone signalling channel : The pulse distortion of the signalling channel when operated at signalling speed of 10 impulse per second and with a mark to space ratio of 40/60 or 33 - / 66 - shall not exceed 3ms for a pair of PLCC terminals in back to back operation.

(13) Permissible limits for the variation of overall loss attenuation of the speech channels relative to 800 Hz for back to back operation of one pair of terminal without compander:
   (a) 300-400 Hz - 0.87 dB to + 3 dB
   (b) 400-600 Hz - 0.87 dB to + 1.74 dB
   (c) 600-1200 Hz - 0.87 dB to + 0.87 dB
   (d) 1200-1600 Hz - 0.87 dB to + 1.74 dB
   (e) 1600-2000 Hz - 0.87 dB to + 3 dB

(14) Service conditions:
   (a) Supply voltage with battery operation : 48V DC + 20% & 48V DC - 10%.
   (b) Carrier set should have ‘miniature circuit breaker’ to provide safeguard against ‘over current’, ‘Over voltage’ etc. Separate fuses for protection against these hazards shall not be preferred.
   (c) All the generated frequencies in the carrier set viz. HF, IF & AF should be derived from a single high frequency crystal to ensure stability.
   (d) The PLCC terminals shall be operated with SLDC scheme to transmit various data to SLDC, Heerapura. At some places the data will be transmitted by repeating at 3 to 4 stations. Thus to ensure correct data transmission, the difference between the transmit and receive frequency in one link should be 0 (Zero).

The bidder/supplier should explain in detail as to how this has been achieved in the carrier sets offered by him.
## TYPE TESTS FOR CARRIER TERMINAL:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Test</th>
<th>Reference as per IEC-495</th>
<th>Reference as per IS 9482-1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Carrier Frequency Side</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Nominal Impedance return loss and tapping loss</td>
<td>Clause No. 5.2.2</td>
<td>Clause No. 6.2.2</td>
</tr>
<tr>
<td>2.</td>
<td>Balance to ground</td>
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4.0 PROTECTION COUPLER:

4.1 The bidder shall offer voice frequency transmission equipment which shall work on frequency shift or coded signal principle for transmission/reception of protection signals. The equipment is to be used together with the PLC equipment. The equipment shall be suitable for permissive, blocking signals as well as direct trip signal. The equipment shall be designed in accordance with IEC 834-I & II. The type test report conforming to this shall be enclosed. The protection coupler shall be suitable for transmission/reception of four commands and it shall be possible to programme them as two coded and two uncoded commands.

Irrespective of whether coded or uncoded transmission the trip signal frequency should fall within the speech band without any necessity of separate band for protection commands. Whenever the protection coupler receives the command, it shall disconnect the speech. This interruption will continue for a short period of the tele-protection command after which the normal operation of the carrier equipment will be restored. During transmission of tele-protection signals or when a fault has been detected by the protective relays the entire output power of the carrier will be made available for transmission of tele-protection signals. Bidder shall specify the transmitting frequencies for uncoded as well as coded transmission.

The total transmission time for teleprotection signals shall not exceed 20 ms for permissive trip and 30 ms for direct trip.

The protection coupler shall use microprocessor based technique with digital signal processing to meet the stringent requirements for commands transmission over PLC links even under adverse channel conditions. The Digital Counters/suitable devices shall be provided for counting of transmitted & received commands.

4.2 The bidder shall offer suitable VFT and interface equipment for this. The equipment offered shall be co-ordinated with the distance relays, phase comparison scheme. The details of the protective scheme employed/ being employed shall be furnished to the successful bidder & the responsibility of co-ordination for a satisfactory performance rests with him. The equipment offered for carrier protection shall have immunity against impulse type of noise which is quite common in power system. The equipment shall be complete with built in counters for counting number of trip commands sent and number of trip commands received.

4.3 The equipment to be provided under this section is required to initiate or receive a tripping signal which will energize the trip coil of selected breaker for single pole tripping and reclosing or three pole releasing, the appropriate type of tripping being selected by the distance relays and auto reclosing relays incorporated in the control equipment.

4.4 (a) The transfer trip channel shall provide the transmission path for either trip or guard for blocking signal by transmitting one or the other of two possible tone but never both. A signal to noise ratio detector associated with the logic circuits shall be provided, so that when a high signal to noise conditions exist in the system, the trip and guard output are blocked and an annunciations given for this. The circuit breaker shall be prevented from tripping under these conditions, the equipment shall be so arranged that both tripping and guard signals be present or absent in the channel as a result of noise or a break in transmission line and the equipment is held in guard or blocking condition, as the case may be. An alarm shall be given by a set of contact provided in circuit for indicating the blocking condition.

(b) The trip signal shall be initiated by a mercury vetted relay or solid state gate associated with the trip circuit of the line breaker. The contacts of this relay shall key the transfer trip transmitter initiating the shift frequency of its transmitted tone from guard to trip frequency. On reception of the trip tone at the remote terminal a relay will be energized, closing three contacts. These contacts in conjunction with the local line relaying equipment
will trip the proper breaker. Other method of initiating tripping at the remote end may be included by the bidder but the same shall provide the facilities mentioned above.

4.5 The bidder shall offer variable frequency transmission equipment for the protection signal. During transmission of line protection signals or when the fault has been located by the protective relays, speech channel in the carrier set and other unimportant super imposed signals shall be disconnected and the entire power of the carrier set will be made available for transmission of line protection signals. The carrier protection channel shall be provided in such a manner that the time interval that elapses between the instant commands is received from protection relays from the transmitting side and the time this command is passed to the protection relays at the distance side shall be less than 20 milli seconds.

4.6 The carrier protection equipment shall be offered for transmission of single or double circuit protection depending on whether the HT line is single circuit or double circuit. The protection equipment shall be provided with interconnection unit suitable for connection to the protective relays. It should be possible to test operational reliability of the protection channel over the carrier link. It should be possible to test the protection link from either of the two ends. During healthy conditions of the transmission line this test procedure must not initiate any tripping command.

4.7 Due to acute shortage of PLCC frequency that can be made available for new channels it shall be preferable if the speech channels and the line protection signals are arranged in such a manner that the superimposed signaling frequency band is kept free for tele-metering and tele-printing. In other words, transmission of line protection signal should be placed within the speech band of equipment but not in superimposed signaling band.

4.8 The equipment offered should not only be insensitive to corona noise which exists on high tension lines but also against impulse type of noise which is created by operation of circuit breakers, isolators, speech and electrical surges. Bidders shall explain clearly how their equipment has been rendered insensitive to corona noise and impulse type of noise. The equipment shall be unaffected by spurious tripping signals.

5.0 TRANSFER TRIP TRANSMITTER:

The transfer trip transmitter shall operate on the frequency shift principle and the channels shall be spared in the frequency band 2200 c/s to 3400 c/s or 300 to 2000 c/s as the case may be such that there is no significant mutual interference between channels. The transmitter shall have an output amplifier followed by filter network to ensure a minimum harmonic content and to provide high impedance to any adjacent channel.

6.0 TRANSFER TRIP RECEIVER:

The transfer trip receiver shall operate in conjunction with the transfer trip transmitter as described in this section. The receiver shall be sufficiently sensitive to accept and maintain proper operation, performance with an input of 40 dBm for full limiting. The line attenuation for the signals shall be such that the average signal to noise ratio of the receiver should be more than 20 dB during fault conditions and the AVC circuit shall be designed for obtaining this value.

The transfer trip receiver shall have an associated output relay with three separate contacts which shall close/open in response to the receiver output signal. These contacts will each be required to carry trip current of approx. 10 Amps. but not to break.

7.0 SUPERVISORY DEVICE:

A continuous carrier supervision at the receiving end and the sending ends shall be incorporated for the carrier channels. As soon as the carrier level drops below a reliable
transmission level, the breaker shall be prevented from tripping as a result of interference from impulse. The visual as well as audible alarm shall be available for this supervision.

TYPE TESTS FOR PROTECTION COUPLER:

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8.0 EARTHING:

The PLCC equipments and associated accessories should be separately earthed and earthing strip should be connected with main earthing mesh.

9.0 COMMISSIONING TESTS:

The following tests shall be carried out on complete system during commissioning:

(i) Composite loss and return loss on coupling devices using dummy load.
(ii) Composite loss (attenuation) for H.F. cable with coupling device.
(iii) End to End attenuation measurement.
(iv) A.F. frequency response (End to End) for entire 4 KHz bandwidth.
(v) Commissioning and testing of protection coupler.

Note: Necessary test instrument required for all the above tests shall be brought by commissioning Engineer of the contractor.

10.0 ROUTINE AND ACCEPTANCE TESTS:

All the Equipment/material covered in PLCC system shall be subjected to the routine and acceptance tests as per the relevant standards before dispatch.
TECHNICAL SPECIFICATION OF OPTICAL LINE TERMINAL EQUIPMENT WITH INTEGRATED ACCESS MULTIPLEXER

1.0 SCOPE:

The scope of the specification covers design, engineering, manufacture, supply, installation, testing and commissioning of optical line terminal equipment and associated multiplexer equipment, digital cross connect and Network Management system to provide Optical fiber communication between 765 kV Substation Bhadla II (PGCIL) and 220/33 kV PPS 1, 2, 3 & 4 Nokh Solar Park (RSDCL) as per requirement and the communication links described in Project Section.

2.0 General requirements

2.1 The equipment shall provide a range of access interfaces for telephony, data and LAN. Transport facilities shall include optical and electrical STM-1 SDH & ATM aggregate interfaces (155Mbit/s) and a range of PDH optical and electrical interfaces.

2.2 The digital multiplex equipment shall be universal, software-controlled, and provide various interface cards to connect tributary interfaces signals such as voice, tele-protection and data to aggregate interfaces. On aggregate level 2Mbit/s electrical and 8Mbit/s optical interfaces complying with ITU-T recommendations G.703 / G.704 shall be provided. Optical STM-1 aggregate interfaces on 155Mbit/s shall be available. The equipment shall be modular in construction and shall form an integrated part of a 19" shelf.

2.3 The platform shall have means to cross-connect, drop and insert VC12 (with termination), 2Mbit/s G.703 unframed signals, and 2Mbit/s G.704 framed signals and individual 64kbit/s timeslots. Path protection on VC12, 2Mbit/s and 64kbit/s shall be supported.

2.4 The equipment shall be suitable for operation in electrical environment in EHV substations with high Electromagnetic Interference. The equipment shall be highly reliable and provide secure communications for real time signals such as voice, SCADA, tele-protection and status/control signals. The equipment offered shall already be working successfully in telecommunication networks operated by power utilities at least for two years as on the date of bid opening. It shall comply with the latest ITU-T recommendations and ETSI standards.

2.5 Each network element shall be manageable from an operation centre and there shall be means to supervise external/existing equipment. It must be possible to access the platform over a common TCP-IP network.

2.6 To adapt transmission to higher bit rates, the equipment shall allow the integration into STM-4 or STM-16 networks by adding higher order SDH equipment.

2.7 Modules for the following user signals shall be available as plug-in units for the equipment:
   - Analogue subscriber interface: subscriber and exchange side
   - 4-wire E&M voice interface
   - G.703, 64kbit/s data Interface
   - X.24/V.11 (RS-422), nx64kbit/s data interface
   - V.24/V.28 (RS-232), data interface
   - V.35, nx64kbit/s data interface
   - Alarm collection interface
   - Tele-protection command interface
   - Optical protection relay interface
   - Binary signal (status and control) interface
   - 2Mbit/s electrical interface for unframed signals acc. to ITU-T G.703 and framed signals acc. to G.703 and G.704.
   - LAN interface 10/1 OOBaseT Ethernet
   - ISDN U interface

The equipment shall provide the following integrated aggregates:

   - Up to four STM-1 SDH optical ports for medium and long distances, with automatic laser shut down programmable on each interface.
• Up to four STM-1 SDH electrical ports
• Up to two STM-1 ATM optical port
• Up to eight 8Mbit/s optical ports

2.8 Desired technical parameters of equipment is appended at ANNEXURE-V2-P2-S5-1

3.0 Tele-protection Requirements

The Tele-protection and communication system has to ensure the easy and secure function of the tele-protection. Therefore following features have to be provided:

- At least a 8 bit command addressing for teleprotection signal shall be provided to prevent tripping if the signal is inadvertently re-routed through the telecommunication network.
- An automatic and periodic loop test (<100s) has to be provided for a signal delay measurement.
- A switch-over of the teleprotection command in less than 10 ms has to be guaranteed.
- The configuration of the teleprotection has to be integrated into the communication configuration tool in order to ensure an easy maintenance.

4.0 General Conditions

The equipment shall be capable of functioning as a terminal, in 'through connection' (transit, repeater) mode and as add-drop multiplex. First order multiplexing (2Mbps), second order multiplexing (8Mbps) and STM-1 multiplexing shall be integrated. Conference for voice channels and point to multipoint function for data signals shall be possible. The equipment shall be of fully modular design.

4.1 Channel capacity: Digital Cross Connection

The equipment shall be equipped with redundant, de-centralized cross-connection functions. The cross-connect capacity shall be at least 40x 2Mbit/s (i.e. 1200x 64kbit/s) and non-blocking. It shall cross-connect 64kBit/s as well as 2Mbit/s (G.703 unframed and G.704 framed) and VC12. The cross-connect shall be capable of cross-connecting the SDH overhead with any 64kBit/s timeslot on the system. On addition the equipment shall offer an SDH cross-connect capacity of at least 4xVC-4 in the same equipment.

4.2 Redundant centralized functions

The equipment shall be equipped with redundant circuits for all centralized functions.

4.3 Power Supply

4.4 The equipment shall operate from a nominal 48Volt-dc battery with positive ground. The equipment shall work satisfactorily over battery voltage variations of + or - 15% (40.8 volts through 55.2 volts). Redundant power-supply (N+1 protection) shall be provided. The equipment shall support dual power feed i.e. that two power sources can be connected directly to the equipment. Furthermore an integrated power module for direct powering from 230VAC shall be available.

4.5 Safety

The equipment shall be safe to use and shall comply with EN 60950 class V1.

4.6 Electromagnetic compatibility and safety regulations
The equipment shall comply with the EN50022 class A, EN50082, IEC 801-2, IEC 801-6.

4.7 Ambient Conditions: As per this tender document.

4.8 Mechanical construction

The equipment shall be available as a 19" shelve to be mounted in a 19" rack or 19" cabinet. It shall be of robust design. All tributary and aggregate units shall be integrated in the same shelf. All connectors shall be accessible from the front and comply with international specifications. The minimum cabinet depth required shall be indicated.

4.9 Network configuration/management system

The Network Management System shall be used to supervise the PDH, SDH and teleprotection system. For teleprotection the configuration and management has to be fully integrated and comprehensive alarm information (severity and exact alarm description) shall be available in the same management system.

The network management system (NMS) shall have facilities to supervise, monitor, control and configure the network. It shall have capabilities of fault, configuration, performance and security management. It shall provide various views to the network such as geographical overview, logical network structure, and hierarchical view. The network management system shall allow defining different user profiles.

A comprehensive alarm management shall show current alarms such, that icons of the network elements change their colors according to the alarm level. The alarms shall be categorized as critical, major, minor alarms and of the warnings and a summary shall indicate the total number of them in the entire network. An alarm list shall list all alarms of the entire network according to the time of their occurrence. It shall be possible to filter alarms with various filter criteria. Operators shall be able to add comments to the alarms. The NMS and the Network Element shall support connections over a TCP-IP based network. The management system shall offer a SNMP interface for alarm integration into higher order networks.

The facility of alarms over an extended period shall be preferred.

4.10 Local User Terminal

It shall be possible to connect the craft terminal to any network element in the network using the TCP-IP protocol. The craft terminal shall support configuration, maintenance, and status information. It shall provide a 'windows' oriented user interface.

4.11 1+1 Path protection

The equipment shall provide means to protect 64kBit/s channels. The protection shall be end to end from one interface (telephone or data) to the other. It shall switch automatically from the main channel to the standby channel. It shall be configurable whether the system switches back to the main channel (reversible switching) or not (non-reversible).

If a path has switched to its standby route because the main route is disturbed this shall be indicated with an alarm. The switching shall be done within the multiplexer without using the Network Management System.

4.12 1+1 Section protection

The equipment shall provide means to protect STM-1 and 8M bit/s connections. It shall be possible to use two independent links: one as the main and the other as the standby. The system shall automatically switch to the standby connection and generate an alarm if the main connection is disturbed.

The switching shall be done within the multiplexer without using the Network Management System.
4.13 **Network Topology**

It shall be possible to build point-to-point, linear, ring, T, and meshed networks.

4.14 **Synchronization**

It shall be possible to synchronize the equipment using an external clock source, derived from a network or with an internal oscillator. The synchronization shall be configurable and it shall be possible to distribute the synchronization to other equipment as well. The system shall have the means of switching to select the synchronization source as well as a means of preventing the system from creating synchronization loops. The equipment shall be capable of selecting the source of synchronization by means of the SSM (Synchronization Status Messaging) feature according to ITU-T G.704 or priority a based sequence. For tele-protection event recording it shall be possible to synchronize the clock of all tele-protection interfaces with one GPS in one station. The GPS time shall be distributed over the tele-protection channel.

4.15 **Alarms**

Each module shall supervise its functions and shall have an alarm-indication LED on its front. All alarms shall be collected by the NMS. Each node shall be capable of collecting up to 50 external alarms.

4.16 **Test Loops**

The equipment shall provide means to loop signals on 64kBit/s level as well as on 2Mbit/s level. It shall indicate an alarm if a loop is activated.

4.17 **Maintenance facilities**

Every Network Element shall have a built-in Signal Generator and Analyzer to analyze communication paths. It must be possible to connect the Generator and Analyzer to the communication channels and terminate the signal on other Network Elements. It shall be possible to configure circuits locally with the craft terminal and remotely from the NMS or the craft terminal. It shall be possible to loop-back signals locally and remotely using the craft terminal or the NMS.

5.0 **Requirements for Transport Level**

5.1 **SDH Aggregate Units**

The interface shall be designed for use on single mode fibre (conforming to ITU-T G.652) at 1310nm the optical connectors shall be E2000
The following main functions shall be supported: Termination of the OS-, RS-, MS- and VC-4 layer Extraction and insertion of the SDH communications information through connections of VC-12 and VC-3
The following maintenance functions shall be supported: Status indications Loops Restart after ALS TTI monitoring BIP Error Insertion
The following SDH interfaces shall be available: STM-1 (155Mbit/s) optical 1 -port interface STM-1 (155Mbit/s) optical 2-port interface
This interface shall provide Multiples Section Protection (MSP): 1+1 Section Protection STM-1 (155Mbit/s) electrical 1 -port interface
Furthermore optical ATM STM-1 interfaces at 1310nm shall be available.

Following main functions shall be supported:
Termination/generation of ATM cells using AAL1/CCS, AAL2/LES Multiplexing and cross connecting of ATM VCs/VPs

5.2 PDH Aggregate Units

Up to four 8Mbit/s optical interfaces (1310nm) shall be available. Each interface shall provide at least 2 x 2Mbit/s (G.703) electrical interfaces and have an integrated switch matrix to convert the incoming optical stream directly into an electrical G.703 stream. On addition up to four 34Mbit/s electrical interfaces shall be available.

6.0 Tributary Units

6.1 4-Wire Interface (VF interface)

This interface shall provide 8/16 voice channels with a bandwidth of 300 HZ -3.4 KHZ and 2 signaling channels (M => E, M' => E') per voice channel. Each interface shall be configurable to operate with or without CAS. With CAS it shall use the "a" and "b" bits for the two signaling channels, as per CCITT recommendations G711 and G712.

The level shall be software adjustable within the following range:
Input: +7.5 to -16dB
Output: +7.0 to -16dB
Modules where each interface can be individually configured with 1+1 path protection shall be available.

6.2 Analogue Subscriber Interface

An interface with at least 10 subscribers as well as high-density analogue subscriber card with up to 30 subscribers shall be available. The ringing generator shall be integrated in the subscriber module interface. The ringer frequency shall be adjustable for 20Hz, 25Hz, and 50Hz. The following main functions shall be supported:

Downstream signaling: Ringing Metering Polarity reversal Reduced battery No battery
Upstream signaling: On/off-hook Pulse and DTMF dialing Flash impulse Earth key
General: Constant current line feeding Line test Permanent line checks CLIP (On-hook VF transmission) Metering after on-hook

6.3 Exchange Interface

This interface shall provide at least 10 ports for connection to remote analogue subscribers to an exchange. It shall provide the following functions:
pulse dialing
tone dialing (DTMF)
earth key function
metering function(12 kHz or 16kHz)
flash impulse
polarity reversal
indication of busy lines

The following parameters shall be configurable by software:

input voice level -5..+4dB
output voice level -7.5..-1dB
metering pulse enable/disable
signaling bit definition
loop back of voice to the telephone


6.4 **Party line Telephone System (Engineering Order Wire)**

An engineering order wire (EOW) facility shall be provided at each multiplexer. Following options shall be available:

1. The EOW shall be configured as a party line and use in band DTMF signaling to call another EOW-Terminal. The Terminal shall have an integrated DTMF decoder allowing to program a subscriber call number (1...4 digits), and two group call numbers (1...4 digits each).

2. EOW based on Voice over IP (VoIP). The EOW traffic shall be routed over the management channel.

6.5 **V. 24/V.28 RS232 Interface**

It shall support the following bit rates:

- 0 to 0.3 k bit/s transp. (V.110)
- 0.6 To 38.4kbit/s synchronous / asynchronous (V.110).

Modules where each interface can be individually configured with 1+1 path protection shall be available.

6.6 **Data Interfaces**

Following interfaces shall be available:

- V.24/V.28, V.11/X.24, V.35, RS485

Following bit rates shall be supported:

- Synchronous and asynchronous: 0.6 to 38.4 k bit/s in steps of 0.6 k bit/s x 2^n (n = 0 ... 6)
- Synchronous: 48, 56, n x 64 k bit/s (n = 1 ... 31)

Following options shall be available: 1+1 path protection, sub rate multiplexing, point-multipoint, performance monitoring.

6.7 **64kBit/s Co-directional Interface**

This interface shall comply with the ITU-T G.703 part 1.2.1 for co-directional data transfer. A module shall have at least 8 interfaces. Modules where each interface can be individually configured with 1+1 path protection shall be available.

6.8 **10/100 Base T Ethernet Interface:**

A 10/100 BaseT interface shall be available. Following specification shall be covered:

- Ethernet connection: 10/100 Base T
- Switching: bypass mode for IEEE Std 802.3 frame or based on port or VLAN tag ID
- WAN capacity: 63xVC-12 or 3xVC-3
- Logical WAN ports (LWP): minimum 8
- Framing: according General Framing Procedure GFP (ITU-T G.7041)
- Features: Virtual Concatenation (VCAT) acc. ITU-T G.707 Link Capacity Adjustment Scheme (LCAS) acc. ITU-T G.7043

On addition an Ethernet Router interface shall be available with following function:

- Ethernet connection: minimum 10BaseT
- Routing Protocols: static IP route, OSPF2 V2
- WAN protocols: PPP, Frame Relay (including RFC 1490)
- WAN capacity: nx64kbit/s (n=1 to31)

6.9 **Alarm Interface**
This interface shall provide means to collect various alarms, which will be displayed, on the Network Management System. It shall be used to manage non-PDH equipment with the PDH Network Management System. It shall have at least 24 binary inputs and at least 4 outputs, which can be switched by the Network Management System. It shall be possible to connect an input to an output so that if an alarm occurs, the output contact will be switched. It shall be possible to label an alarm. The label-text shall be read from the interface module so that it can be indicated on the Network Management System as well as on the local craft terminal.

6.10 Tele-protection Interface

This interface shall provide means to transmit four bi-directional command channels. The signals shall be adjustable from 24 to 250VDC by means of software. All inputs and outputs shall be isolated and with EMC immunity for harsh environment. Security, Dependability and Transmission speed shall be selectable and programmable. It shall be able to drop and insert commands, transfer commands as a transit station, it shall be possible to have AND-and OR-connections between commands. The interface shall support T-node configurations. The Teleprotection interface shall provide an integrated non-volatile event-recorder, which shall be synchronisable either internally or by Global Positioning System (GPS) and a command counter, which counts trip commands. The teleprotection interface shall provide means for signal delay measurement. 1+1 protection must be available; the switching shall be done within less than 4ms (typical value). The interface shall do automatic loop test periodically (preferably every 60s). The bidder shall confirm that under no circumstances will the interface cause trip-commands in case of power supply failure or when equipment is put into or taken out of service. Command addressing shall be used to prevent tripping if the signal is inadvertently rerouted through the telecommunication network.

6.11 Optical Protection Relays Interface

This interface shall have an optical port to connect protection relays for teleprotection to the multiplexer. It shall operate according IEC 870-5-1, format class FT 1.2 on 1300nm using MCMI line coding.

6.12 Binary Contact Interface

This interface shall provide means to transmit binary signals. The inputs and outputs shall be isolated.

The inputs shall be suitable for 24VDC to 60VDC.

Outputs shall be solid-state relays.

The interface shall provide a 24VDC short circuit proofed auxiliary power supply.

It shall be able to drop and insert commands, transfer commands, as a transit station and it shall be possible to have AND- and OR-connections between commands. The Teleprotection interface shall provide an integrated event recorder, which shall be synchronisable either internally or by GPS.

6.13 Mbit/s G.703 / G.704 Interface

This interface shall comply with the ITU-T G.703 and G.704 recommendations. The interface module shall have at least four interfaces, each of which may be individually activated. It shall be possible to have up to 126 x 2Mbit/s interface modules in a multiplexer. In order to connect different equipment, the interfaces shall be available with the impedance of 120 ohms and 75 ohms. The interface shall support CRC-4 multi-frame according to ITU-T G.704 (enabled and disabled by software). The CAS signaling according to ITU-T G.704 table 9 shall be activated optionally.
The interface shall be able to extract the 2.048MHz clock, which can be used to synchronise the multiplex equipment. The interface module shall support 2Mbit/s Loop-back of the incoming signal as well as the loop-back of the internal signals.

6.14 **ISDN U interface**

There shall be ISDN U interfaces available for subscriber and exchange side. The interface shall be based on 2B1Q code and provide at least 8 ISDN U lines.

7.0 **DIGITAL DISTRIBUTION FRAME**

At each terminal site, a digital distribution frame (DDF) shall be provided. The DDF shall be used to interface and / or cross-connect the digital multiplex equipment at 2 Mb/s, 8 Mbps, 155 Mb/s manually in the first instance for the present. Provision shall be made in the DDF to effect the interface/cross connect changes by software also.

The following basic functions of the DDF are required.
- circuit Re-routing / jump ring
- circuit Disconnection
- patching and test connections
- Bridging measurements
- Terminating measurements.

Individual Distribution Circuits shall use Co-axial type of jacks / Uplinks, and shall permit bridging measurements. No break circuit patching (Re-routing) shall be possible. Plug-in connection shall be used, and the transmit and receive direction of transmission should be segregated. The capacity of the DDF shall accommodate the maximum capacity of Communication system equipment i.e., 155 M bit/s.

8.0 It is not intent to specify completely herein all the details of the design, and construction of OLTE and Multiplexer system. However equipment shall confirm in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee, in a manner acceptable to the RSDCL, who will interpret the meanings of drawings and specification and shall have final authority to accept any work or equipment. Notwithstanding to anything contained above, the offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not. The bidder shall not be eligible for extra charges for such material. Further the minimum principal parameters mentioned in the technical specification should be fulfilled.

9.0 **Guarantee:**

The system shall be guaranteed for trouble free operation for 30 months from the date of commissioning or 36 months from the receipt of last consignment of the system whichever is earlier. In case of failure within this period, the contractor shall replace the faulty equipment at no extra costs to the RSDCL.

10.0 **System Availability**

The total system shall satisfy two types of availability: calculated availability and demonstrated availability. The calculated availability will be the theoretical availability determined by a statistical calculation based on the mean - time - between - failure (MTBF) and the mean - time - to - repair(MTTR) of the components and subsystems comprising the fiber optic system.
The demonstrated availability will be an actual measured value determined during the System Availability Test (SAT).

11.0 **Calculated Availability**

The contractor shall submit detailed MTBF and MTTR data and the resulting availability analysis for OLTE and associated equipment. The calculated failure rates of the units shall be listed and using these unit failure rates, the calculated availabilities of the equipment offered in the Bid shall be calculated. The contractor's recommended maintenance and repair philosophy and spare parts inventories shall minimize MTBF and MTTR numbers in support of the calculated availability.

The calculated system availability for fiber optic system shall be not less than 99.95%.

12.0 **Operational Life**

The equipment shall be designed for an operating life of not less than 15 years with recommended servicing and replacement of parts. Such recommended services and replacement of parts shall be brought out in the bid. The contractor shall provide technical support and spare parts for a minimum period of 5 years from the date of final acceptance. The contractor shall indicate the spares required with the unit rates in the relevant price schedule-B2. The contractor shall demonstrate a specified level of functionality of the equipment during tests in the factory. After the equipment is installed, the contractor shall demonstrate all of the functions and availability characteristics during well-structured field tests.

13.0 **Summary of Standards**

The Equipment shall comply with the latest ITU-T recommendations for the plesiochronuous and synchronous hierarchies. The equipment shall be KEMA type tested. In particular the mentioned recommendations shall be covered:

**ETSI**

- ETSI EN 300 386 V1.3.2 (2003-05)
  Electromagnetic compatibility and Radio spectrum Matters (ERM);
  Telecommunication network equipment; Electromagnetic Compatibility (EMC) requirements

**IEC**

- IEC 61000-6-2 (1999-01)
  Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments.
- IEC 61000-6-5 (2001-07)
  Electromagnetic compatibility (EMC) - Part 6-5: Generic standards - Immunity for power station and substation environments. Test: 1.2, 1.3, 2.3 and 2.5

**IEEE**

- IEEE C37.1 (1994)
  IEEE Standard Definition, Specification and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control 6.6 Electromagnetic interference (EMI) and electromagnetic compatibility (EMC).
- IEEE C37.90.2 (1995)
  The PDH interfaces shall conform to the following recommendations:
ITU
- ITU-T G.702: General aspects of digital transmission systems - Terminal equipment - Digital hierarchy bit rates
- ITU-T G.703: Digital transmission systems - Terminal equipment - General Physical/electrical characteristics of hierarchical digital interfaces
- ITU-T G.704: Digital transmission systems - Terminal equipment - General Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736kbit/s hierarchical levels
- ITU-T G.706: General aspects of digital transmission systems - Terminal equipment - Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in recommendation G.704
- ITU-T G.711: Pulse code modulation (PCM) of voice frequencies
- ITU-T G.712: Transmission performance characteristics of pulse code modulation channels
- ITU-T G.732: General aspects of digital transmission systems - Terminal equipment - Characteristics of primary PCM multiplex equipment operating at 2048kbit/s
- ITU-T G.735: Characteristics of primary multiplex equipment operating at 2048kbit/s and offering synchronous digital access at 384kbit/s and/or 64kbit/s
- ITU-T G.736: General aspects of digital transmission - Characteristics of a synchronous digital multiplex equipment operating at 2048kbit/s
- ITU-T G.737: Characteristics of external access equipment operating at 2048kbit/s and offering synchronous digital access at 384kbit/s and/or 64kbit/s
- ITU-T G.823: The control of jitter and wander within digital networks, which are based on the 2048kbit/s hierarchy
- ITU-T G.826: Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate

The architecture of optical SDH interfaces shall conform to the following recommendations:

ETS/EN
- ETS 300 147: Synchronous digital hierarchy multiplexing structure
- ETS 300 417: Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment
  - ETS 300 417-1-1 / EN 300 417-1-1 V1.1.2: Generic Processes and Performance
- ETS 300 417-2-1 / EN 300 417-2-1 V1.1.2: SDH and PDH Physical Section Layer Functions
- ETS 300 417-3-1 / EN 300 417-3-1 V1.1.2: STM-N Regenerator & Multiplex Section Layer Functions
- ETS 300 417-4-1 / EN 300 417-4-1 V1.1.2: SDH Path Layer Functions

ITU
- ITU-T G.707: Network node interface for the synchronous digital hierarchy
  - ITU-T G.805: Generic functional architecture of transport networks
- ITU-T G.826: Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
- ITU-T G.841: Types and characteristics of synchronous digital hierarchy (SDH) network protection architectures
- ITU-T G.957: Optical interfaces for equipment and systems relating to the synchronous digital hierarchy
- ITU-T G.958: Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables
- ITU-T M.2101.1: Performance limits for bringing into service and maintenance of international SDH paths and multiplex section
ITU-T T.50: International Reference Alphabet (IRA) - Information technology 7 bit coded character set for information interchange
The synchronization and timing of optical SDH interfaces shall conform to the following recommendations:

ETS/EN

- ETS 300 417-6-1 / EN 300 417-6-1 V1.1.2: Synchronisation Layer Functions
- ETS 300 462-1 / EN 300 462-1-1 V1.1.1: Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 1: Definitions and terminology for synchronization networks
- EN 300 462-4-1 V1.1.1: Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 4-1: Timing characteristics of slave clocks suitable for synchronization supply to Synchronous Digital Hierarchy (SDH) and Plesiochronuous Digital Hierarchy (PDH) equipment
- ETS 300 462-5 / EN 300 462-5-1 V1.1.2: Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 5: Timing characteristics of slave clocks suitable for operation in Synchronous Digital Hierarchy (SDH) equipment

ITU

- ITU-T G.813: Timing characteristics of synchronous digital hierarchy (SDH) equipment slave clocks (SEC)

14. Abbreviations

AAL ATM Adaptation Layer
ADM Add-drop multiplexed
ATM Asynchronous Transfer Mode
ALS Automatic Laser Shutdown
BIP Bit Interleaved Parity
CAS Channel Associated Signaling
CAP Carrier-less Amplitude and Phase
CRC Cyclic Redundancy Check
DTMF Dual Tone Multi-Frequency
EN European Norm
EOW Engineering Order Wire
ETS European Telecommunications Standards
GPS Global
IEC International Electrical Commission
ITU International Telecommunication Union
IP Internet Protocol
ISDN Integrated Services Digital Network
MCMI Multi Coded Mark Inversion
MS Multiplex Section
NE Network Element
NMS Network Management System
LAN Local Area Network
OS Optical Section
OSPF Open Shortest Path First
PDH Plesiochronuous Digital Hierarchy
PPP Point-to-Point Protocol
RS Regenerator Section
SDH Synchronuous Digital Hierarchy
SNMP Simple Network Management Protocol
SOH Section Overhead
STM Synchronous Transport Module
TCP Transmission Control Protocol
TTI Trail Trace Identifier
VC Virtual Container
VF Voice Frequency
### TECHNICAL DATA OF OFFERED INTEGRATED EQUIPMENT:

**GENERAL:**
- **Type of multiplexer:** SDH: ADM
- **Complying to ITU-T rec.:** Yes
- **Transmission Capacity:** STM-1: 155 Mbit/s
- **Access capacity on 64 kbit/s channels:** Minimum 200
- **Access capacity on 2 Mbit/s channels:** Minimum 40
- **Redundant central processor:** Shall be available
- **Digital cross connect function:** Fully non-blocking
- **PDH cross connect capacity:** Minimum 40x2Mbit/s
- **SDH cross connect capacity:** Minimum 4xVC4
- **Equipment used in substation environment:** List of 10 reference substation projects
- **The equipment is KEMA type tested:** YES

**Tele-protection functionality:**
- **Integrated distance tele-protection functionality:** YES
- **Integrated optical tele-protection functionality:** YES
- **Addressing system for commands:** YES
- **Loop test for delay time:** YES
- **Switch-over less than 10ms:** YES

**Available STM-1 AGGREGATES:**
- **Optical SDH aggregates (ITU-T G.957):** S-1.1, L-1.1, L-1.2
- **Electrical SDH aggregates:** YES
- **Optical ATM aggregates (ITU-T G.957):** S-1.1, L-1.1, L-1.2

**Available TRUNK INTERFACES:**
- **Optical 8Mbit/s interface:** Yes
- **Electrical 34/35Mbit/s interface:** Yes

**Available USER INTERFACES**

**Voice interfaces for trunk lines:**
- **1 + 1 com path protection, available for all:** YES
- **Analogue, 4wire with E&M: Input level Output level dBr:**
  - Input level: +7.5 to -16.7.0 to -16.5
  - Output level: +6.5 to -12.5 -1.0 to -20
- **Digital, 2Mbit/s CAS or PRI:** YES

**Voice interfaces for remote subscriber:**
- **2wire, subscriber side dBr:** -5.0..+4/-7.5..-1
- **Minimal number of subscriber:** 10
- **2wire, PABX side dBr:** -5.0..+4/-7.5..-3
- **Minimal number of PABX:** 10
## Integrated teleprotection

### Interface for Commands:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of independent commands</td>
<td>No. 4</td>
</tr>
<tr>
<td>Transmission time max.</td>
<td>ms 6</td>
</tr>
<tr>
<td>Signal voltage</td>
<td>volts 250 Volts DC</td>
</tr>
<tr>
<td>1 + 1 com path protection</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Interface(s) for Differential Protection:

<table>
<thead>
<tr>
<th>Interface</th>
<th>kbit/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.703</td>
<td>64</td>
</tr>
<tr>
<td>Optical Interface</td>
<td>Minimum 64</td>
</tr>
</tbody>
</table>

### Data: channels per module

- **Integrated LAN port available on DATA interface**: YES
- **V.24/V.28 (RS-232)**: No. 4
- **V.11/X.24 (RS-422)**: No. 4
- **V.35**: No. 4
- **G.703: 64kbit/s**: No. 8
- **Ethernet: 10/100BaseT**: No. 4
- **Logical WAN ports GFP (acc. ITU-T G.7041)**
  - VCAT (acc. ITU-T G.707)
  - LCAS (acc. ITU-T G.7043)
- **Ethernet: Router functionality**: YES
- **Router Protocols**: static IP route, OSPF2 V2, nx64kbit/s(n=11 to31), PPP, Frame Relay (incl. RFC1490)
- **Integrated Ethernet Hub**: 10/100BaseT
  - No. Min. 5

### Integrated alarm gathering module:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of external alarms per module</td>
<td>No. Min. 20</td>
</tr>
<tr>
<td>Auxiliary power supply for ext. contacts</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Configuration Management

<table>
<thead>
<tr>
<th>Type/Name of configuration tool</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For local / remote operation</td>
<td>YES / YES</td>
</tr>
<tr>
<td>Test Name</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Radiated radio frequency interference</td>
<td>30 MHz to 1 GHz</td>
</tr>
<tr>
<td>Conducted radio frequency interference AC/DC Power supply</td>
<td>150 kHz to 30 MHz</td>
</tr>
</tbody>
</table>
### Immunity of the Equipment (Sub Station Environment)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Test Name</th>
<th>Description</th>
<th>Basic standard</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>ESD test</td>
<td>Contact/air discharge</td>
<td>IEC 61000-4-2</td>
<td>6 / 8 kV</td>
</tr>
<tr>
<td>2.2</td>
<td>Radiated electromagnetic field</td>
<td>80 to 1000 MHz, 80% AM, 1 kHz modulated</td>
<td>IEC 61000-4-3</td>
<td>10 V/m</td>
</tr>
<tr>
<td>2.3</td>
<td>Radiated electromagnetic field</td>
<td>1.0 to 2.5 GHz, AM, 1 kHz, modulated</td>
<td>IEC 61000-4-3</td>
<td>10 V/m</td>
</tr>
<tr>
<td>2.4</td>
<td>Fast transient test</td>
<td>AC/DC Power supply: All other ports:</td>
<td>IEC 61000-4-4</td>
<td>4 kV</td>
</tr>
<tr>
<td>2.5</td>
<td>Surge test (1.2/50μs)</td>
<td>AC/DC Power Supply: Common mode differential mode DC Power supply 48 V: Common Mode Differential mode Signal terminals: Common mode Differential mode Telecommunication ports: Common Mode</td>
<td>IEC 61000-4-5</td>
<td>2.0 kV, 1.0 kV, 0.5 kV, 0.5 kV, 2.0 kV, 1.0 kV, 1.5 kV</td>
</tr>
<tr>
<td>2.6</td>
<td>Conducted radio frequency interface</td>
<td>0.15 to 80 MHz, 80% AM, 1 kHz modulated</td>
<td>IEC 61000-4-6</td>
<td>10 V (e.m.f.)</td>
</tr>
<tr>
<td>2.7</td>
<td>Power freq. magnetic field</td>
<td>Continuous Short (1 to 3s)</td>
<td>IEC 61000-4-8</td>
<td>30 A/m, 300 A/m</td>
</tr>
<tr>
<td>2.8</td>
<td>Damped oscillatory waves</td>
<td>AC/DC Power supply: Common mode Differential mode Signal terminals: Common mode Differential mode Telecommunication</td>
<td>IEC 61000-4-12</td>
<td>2.5 kV, 1.25 kV, 2.5 kV, 1.25 kV, 2.5 kV</td>
</tr>
<tr>
<td>2.9</td>
<td>Conducted common mode disturbance</td>
<td>Frequency 50 Hz continuous mode</td>
<td>IEC 61000-4-16</td>
<td>10/30 Vrms</td>
</tr>
</tbody>
</table>

Bidder shall provide all necessary information that deems to be necessary to complete the project in all respects.
1.0 General

1.1. The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre. The SAS shall contain the following main functional parts:

- Bay Control Intelligence Electronic Devices (IEDs) for control and monitoring compliant to IEC 61850.
- Bay Protection Intelligent Electronic Devices (IEDs) for protection compliant to IEC 61850.
- Station Human Machine Interface (HMI)
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
- Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101/IEC 60870-5-104 protocol.
- Gateway for remote supervisory control (to SLDC), the gateway should be able to communicate with SLDC on IEC 60870-5-101 with EMC to suit sub station automation environment. The specific protocol to be implemented shall be handed over to successful bidder. It shall be the bidder's responsibility to integrate his offered system with existing SLDC system for exchange of desired data. The exact I/O point shall be decided during detailed engineering.
- Remote HMI.
- Peripheral equipment like printers, display units, key boards, Mouse etc.
- Integrated Switches (built in bay IEDs) are not acceptable. All the IEDs shall be directly connected to Ethernet Interbay LAN without use of any gateways. The use of Ethernet Hubs shall not be permitted.

1.2. It shall enable local station control via a PC by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions.

1.3. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed at Annexure-V2-P3-S2-1 & 2.

1.4. The communication gateway shall facilitate the information flow with remote control centres. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

1.5 The bidder shall ensure that proposed automation system is compatible with the existing SCADA (if applicable) network. The bidder will quote for the equipment required for data transfer to the existing SCADA network, including SCADA equipment for which PLCC/FOTE shall be used for communication with NRLDC/SLDC and the other adjoining stations. Layout details of Automation equipment has been considered to be as follows:

Bay level intelligent electronic devices (IED) for protection and control shall be provided for each bay. Each IED will be directly connected to the Hot Standby Server PC of the Station Automation System (SAS) through a dual managed Ethernet LAN on fiber optic media and shall communicate as per the IEC 61850 standard. The SAS shall be equipped with the gateway for remote communication as detailed further in the specification. SCADA details will be communicated to nearest SLDC via adjoining sub stations and signal will be carried by PLCC/ FOTE. The Contractor will make arrangement for supplying terminal equipment required for communication. The existing communication system works on IEC-60870
The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions. The systems shall be of the state-of-the-art suitable for operation under electrical environment present in Extra high voltage substations, follow the latest engineering practice, ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff. The offered SAS shall support remote control and monitoring from Remote Control centers via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records. Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the Bay level unit (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer), bay mimic along with relay and protection panels (described in other sections of technical specifications) and Station HMI housed in air-conditioned Control Room building for overall optimization in respect of cabling and control room building.

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.

The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level. At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station. The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fiber-optic cables, thereby guaranteeing disturbance free communication. The fiber optic cables shall be run in G.I
conduit pipes. Data exchange is to be realized using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure.

The communication shall be made in 1+1 mode, excluding the links between individual bay IEDs to switch, such that failure of one set of fiber shall not affect the normal operation of the SAS. However it shall be alarmed in SAS. Each fiber optic cable shall have four (4) spare fibers.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realized at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centers.

The GPS time synchronizing signal (as specified in the section relay & protection) as per IEC 61850 standard SNTP (Simple Network Time Protocol) for the synchronization of the entire system shall be provided. The SAS shall contain the functional parts as described in Para 1.1 above.

### 2.3 Functional Requirements

The high-voltage apparatus within the station shall be operated from different places:

- Station HMI
- Local Bay controller IED (in the bays)
- Remote control centers

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchro check, etc. (See description in “Bay level control functions”).

#### 2.3.1 Select-before-execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

#### 2.3.2 Command supervision

**Bay/station interlocking and blocking**

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for Bus Earth switch Interlocking.

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails. A software interlock override function shall be provided which can be enabled to bypass the interlocking function.
2.3.3 Run Time Command cancellation
Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

2.3.4 Self-supervision
Continuous self-supervision function with self-diagnostic feature shall be included.

2.3.5 User configuration
The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). Multi activation of these additional functions should be possible.

The Functional requirement shall be divided into following levels:
a. Bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) Level Functions
b. System Level Functions

3.1. Bay level functions
In a decentralized architecture the functionality shall be as close to the processes possible. In this respect, the following functions can be allocated at bay level:

• Bay control functions including data collection functionality.
• Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection function.

3.1.1 Bay control functions
3.1.1.1 Overview

Functions
• Control mode selection
• Select-before-execute principle
• Command supervision:
• Interlocking and blocking
• Double command
• Synchrocheck, voltage selection
• Run Time Command cancellation
• Transformer tap changer control (for power transformer bays)
• Operation counters for circuit breakers and pumps
• Hydraulic pump/ Air compressor control and runtime supervision
• Operating pressure supervision
• Display of interlocking and blocking
• Breaker position indication per phase
• Alarm annunciation
• Measurement display
• Local HMI (local guided, emergency mode) to display the single line diagram, status information, alarms and disturbances etc. with password protected access.
• Interface to the station HMI.
• Data storage for at least 200 events
• Extension possibilities with additional I/O's inside the unit or via fiber optic communication and process bus

3.1.1.2 Control mode selection

Bay level Operation
As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

Emergency Operation
It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

Remote Mode
Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

3.1.1.3 Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:
• Settable voltage, phase angle, and frequency difference.
• Energizing for dead line - live bus, live line - dead bus or dead line dead bus with no synchro-check function.
• Synchronizing between live line and live bus with synchro-check function.

Voltage Selection
The voltages relevant for the Synchrocheck functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

3.1.1.4 Transformer Tap Changer Control

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

3.1.2 Bay Protection functions
3.1.2.1 General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions.
The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

All the IEDs must be fully IEC61850 compliant and shall be directly connected to the Ethernet Interbay LAN without use of any gateways.

**Event and Disturbance Recording Function**

Each IED should contain an event recorder capable of storing at least 200 time-tagged events. This shall give alarm if 70% memory is full. The disturbance recorder function shall be as per detailed in section Relay and Protection.

3.2. **System Level Functions**

3.2.1 **Status Supervision**

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list, and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recoded through this IED.

3.2.2 **Measurements**

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (V) and current (I) shall be calculated.

The measured values shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

3.2.3 **Event and Alarm Handling**

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms.
3.2.4 Station HMI

3.2.4.1 Substation HMI Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode.

3.2.4.2 Presentation and Dialogues

General

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks or keyboard commands.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked.
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

3.2.4.3 HMI Design Principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

3.2.4.4 Process Status Displays and Command Procedures
The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram. In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for nonfunctioning.

3.2.4.5 System Supervision & Display

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

3.2.4.6 Event List

- The event list shall contain events that are important for the control and monitoring of the substation.
- The event and associated time (with 1 ms resolution) of its occurrence has to be displayed for each event.
- The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.
- A printout of each display shall be possible on the hard copy printer.
- The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measure and.
- Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:
3.2.4.7 Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated. The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:
The date and time of the alarm: __________________
The name of the alarming object: ________________
A descriptive text: _____________________________
The acknowledgement state: ______________________

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm list (Unacknowledged and persistent, Unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

3.2.4.8 Object Picture

When selecting an object such as a circuit breaker or isolator in the single line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like
- Type of blocking
- Authority
- Local / remote control
- RSCC/SAS control
- Errors etc., shall be displayed.

3.2.4.9 Control Dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. It shall also be possible to use the keyboard for command activation. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:
- Breaker and disconnector
- Transformer tap-changer
3.2.5 User-Authority Levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

3.2.6 Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

Trend reports:
- Day (mean, peak)
- Month (mean, peak)
- Semi-annual (mean, peak)
- Year (mean, peak)
  Historical reports of selected analogue Values:
  - Day (at 15 minutes interval)
  - Week
  - Month
  - Year

It shall be possible to select displayed values from the database in the process display on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

i. Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.
ii. Weekly trend curves for real and derived analogue values.
iii. Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr period.
iv. Provision shall be made for logging information about breaker status like number of operation with date and time indications.
v. Equipment operation details shift wise and during 24 hours.
vi. Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of pumps and fans for transformers.

vii. Printout on adjustable time period as well as on demand system frequency and average frequency.

viii. Print hourly/daily log sheet of the sub-station based on available input parameters (format will be decided/ finalized during detailed engineering).

ix. Calculate various indices such as voltage variation, voltage unbalance, SAIFI, SAIDI, frequency variation, system availability etc. as per Regulatory Commission requirements.

x. Generate the report for these indices at (ix) above by selecting the appropriate data for various time horizons by the user.

xi. Assign the type of interruption outages through a dropdown menu, so that the actual fault tripping (excluding tripping due to load shedding, nature act etc.) can be segregated.

xii. Change the category / labels/data for calculation of these indices by the authorized user.

xiii. Have maximum flexibility in the report generation software for modification requirements. The source code/algorithm is also required to be provided for future report generation/ modifications.

xiv. Provide maximum flexibility to the user for generating various reports for analysis and in order to meet the Regulatory Commission requirements.

xv. Reports in specified formats/ formats finalized during detailed engineering shall be handed over to successful bidder for implementation.

3.2.7 Trend Display (Historical Data)

It shall be possible to illustrate all types of process data as trends - input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

3.2.8 Automatic Disturbance File Transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

3.2.9 Disturbance Analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

3.2.10 IED Parameter Setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.
3.2.11 **Automatic Sequences**

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

3.3 **Gateway**

3.3.1 **Communication Interface**

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations.

The Substation Automation System shall have two communication ports for Remote Control Centre / Sub/State Load Dispatch Center (SLDC)/NRLDC. The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC /SLDC/NRLDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

3.3.2 **Remote Control Centre Communication Interface**

Employer will supply communication channels between the Substation Automation System and the remote control centre. The communicator channels provided by Employer will consist digital PLCC/OFC, the details of which shall be provided during detailed Engineering.

3.3.3 **Interface Equipment:**

The Contractor shall provide interface equipment for communicating between Substation Automation system and Remote control / Sub/State Load Dispatch Center (SLDC)/NRLDC as per detailed engineering and requirement.

In case of communication OFC /PLCC any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity.

The modem should be stand alone complete in all respects including power supply to interface the SAS with communication channel. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software along with communication equipment shall also be in the scope of bidder except the communication link OFC / PLCC between substation control room and Remote Control Centre /SLDC/NRLDC.
3.3.4 Communication Protocol

The communication protocol between gateway and remote station shall be open protocol/ shall support IEC 60870-5-101. For all other levels of communication such as Interbay Level, Bay to station HMI, etc. the communication protocol shall support IEC 61850.

4.0 System Hardware:

4.1 Redundant Station HMI, HMI View Node and Disturbance Recorder

Work station:
The contractor shall provide redundant station HMI in hot standby mode.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days.
2. Storage of all necessary software
3. 20GB space for EMPLOYER'S use. Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

4.1.1 HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, de-cluttering etc.

4.1.1.1 Visual Display Units/ TFT's (Thin Film Technology)

The contractor shall provide three display units, one for station HMI, one for DR workstation and one for redundant HMI. These shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 21" diagonally in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 X 1024 pixels. The HMI shall be able to switch the key board and cursor positioning device, as unit among all the monitors at a console via push button or other controls.

4.1.3 Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.
The printer shall have in-built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off-line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All printers mounted in the control room shall be provided with a separate printer enclosure each. The enclosure shall be designed to permit full enclosure of the printers at a convenient level. Plexiglas windows shall be used to provide visual inspection of the printers and ease of reading. The printer enclosures shall be designed to protect the printers from accidental external contact & each should be removable from hinges at the back and shall be provided with lock at the front.

All reports and graphics prints shall be printed on laser printer. One dot matrix printer shall be exclusively used for hourly log printing.

All printers shall be continuously online.

4.1.4 Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values, and indications shall be stored in a mass-storage unit of CDROM / DVD-ROM with 700 MB or more capacity. The unit should support at least Read (48X), Write(24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet File systems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc.

The facility of back up of data shall be inherent in the software.

4.1.5 Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. The bidder shall keep provision of 100% spare capacity for employer use. Redundant switches shall be provided to connect all IEDs for 220 kV & 33 kV bays to communication infrastructure as required in the substation network panels.

4.2 Bay Level Unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours. The Bay control unit shall be fully compliant to IEC 61850 standard.

One no. bay level unit shall be provided for supervision and control of each bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument
The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service. The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

4.2.1 Input/Output (I/O) Modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

4.3 Control Room

The Control Room shall house Bay level units, bay mimic, relay and protection panels, PLCC panels etc. The placements of these panels in Control Rooms shall be as per the electrical layout/ quantities mentioned elsewhere in the specification. The layout of equipment / panel shall be subject to Owner’s approval. The Control rooms (to be constructed by RVPN) shall be well ventilated having sufficient ceiling fan arrangements.

4.4 Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future with IEDs of same manufacturer/ different manufacturer.

5.0 Software Structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

5.1.1 Station Level Software

5.1.1.2 Human-Machine Interface (HMI)
The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

5.1.2 Bay Level Software

5.1.2.1 System Software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronizing with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

5.1.2.2 Application Software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library. The application software within the control/protection devices shall be programmed in a functional block language.

5.1.2.3 Network Management System

The contractor shall provide a network management system software for following management functions:

a. Configuration Management
b. Fault Management
c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices.

The NMS shall:

(a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
(b) Maintain a graphical display of SAS connectivity and device status.
(c) Issue alarms when error conditions occurs
(d) Provide facility to add and delete addresses and links
5.1.2.4 The contractor shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

6.0 Tests

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for EHV sub station equipment installed in sheltered area in the outdoor switchyard an specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment

a. Power Input:
   i. Auxiliary Voltage
   ii. Current Circuits
   iii. Voltage Circuits
   iv. Indications

b. Accuracy Tests:
   i. Operational Measured Values
   ii. Currents
   iii. Voltages
   iv. Time resolution

c. Insulation Tests:
   i. Dielectric Tests
   ii. Impulse Voltage withstand Test

d. Influencing Quantities
   i. Limits of operation
   ii. Permissible ripples
   iii. Interruption of input voltage

e. Electromagnetic Compatibility Test:
   i. 1 MHZ. burst disturbance test
   ii. Electrostatic Discharge Test
   iii. Radiated Electromagnetic Field Disturbance Test
   iv. Electrical Fast transient Disturbance Test
   v. Conducted Disturbances Tests induced by Radio Frequency Field
   vi. Magnetic Field Test
   vii. Emission (Radio interference level) Test.
   viii. Conducted Interference Test

f. Function Tests:
   i. Indication
   ii. Commands
   iii. Measured value Acquisition
   iv. Display Indications

g. Environmental tests
   i. Cold Temperature
   ii. Dry Heat
   iii. Wet heat
   iv. Humidity (Damp heat Cycle)
   v. Vibration
   vi. Bump
   vii. Shock

6.2 Factory Acceptance Tests:
The supplier shall submit a test specification for Factory Acceptance Test (FAT) and Commissioning Tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted.

The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the Site Acceptance Test (SAT).

6.3 Integrated Testing:

The integrated system tests shall be performed as detailed in subsequent clauses as per following configuration:

- Redundant Station HMI, DR work station, switch(es) along with all IEDs and printers.

All other switches for complete sub-station as detailed in section project shall be simulated as needed.

6.3.1 Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

6.3.2 Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

6.4 Field Tests:

The field tests shall completely verify all the features of SAS hardware and software.

7.0 System Operation

7.1 Substation Operation

7.1.1 Normal Operation
Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields:
   i) Message field with display of present time and date
   ii) Display field for single line diagrams
   iii) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:

- Prompting of indications e.g. fault indications in the switchgear, and
- Prompting of operational sequences e.g. execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

8.0 Power Supply

Power for the substation automation system shall be derived from substation 220V DC system.
Inverter of suitable capacity shall be provided for DR Workstation, station HMI and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown and restart.

9.0 Documentation

The following documents shall be submitted for employer's approval during detailed engineering:
The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format.

List of Drawings
Substation automation system architecture
Block Diagram
Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
Calculation for power supply dimensioning
I/O Signal lists
Schematic diagrams
List of Apparatus
List of Labels
Logic Diagram (hardware & software)
Control Room Lay-out
Test Specification for Factory Acceptance Test (FAT)
Product Manuals
Assembly Drawing
Operator's Manual
Complete documentation of implemented protocols between various elements
Listing of software and loadable in CD ROM
Other documents as may be required during detailed engineering

Two sets of hard copy and Four sets of CD ROM containing all the as built documents/drawings shall be provided.

10.0 Maintenance

10.1 Maintenance Responsibility during the Guaranteed Availability Period

During Guaranteed Availability Period, the Contractor shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational.

11.0 RELIABILITY AND AVAILABILITY

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electrical interface (EMI)
- High quality components and boards
- Modular, well-tested hardware
- Thoroughly developed and tested modular software
- Easy-to understand programming language for application programming
- Detailed graphical documentation and application software
- Built-in supervision and diagnostic functions
- After Sales Service
- Security
  - Experience of security requirements
  - Process know-how
  - Select before execute at operation
  - Process status representation as double indications
- Distributed solution
- Independent units connected to the local area network
- Back-up functions
- Panel design appropriate to the harsh electrical environment and ambient conditions
- Panel grounding immune against transient ground potential rise

**Outage terms**

(a) **Outage**

The state in which substation automation system or a unit of SAS is unavailable for Normal Operation as defined in the clause 7.1 due to an event directly related to the SAS or unit of SAS. In the event, the owner has taken any equipment/system other than substation Automation System for schedule/ forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

(b) **Actual outage duration (AOD)**

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/4\(^{th}\) of an hour. Time less than 1/4\(^{th}\) of an hour shall be counted as having duration of 1/4\(^{th}\) of an hour.

(c) **Period Hours (PH)**

The number of hours in the reporting period. In a full year the period hour are 8760 h (8784 h for a leap year).

(d) **Actual Outage hours (AOH)**

The sum of actual outage duration within the reporting period \( AOH = \sum AOD \)

(e) **Availability**

Each SAS shall have a total availability of 99.98% i.e. the ratio of total time duration minus the actual outage duration to total time duration.
11.1 **Guarantees Required**

The availability for the complete SAS shall be guaranteed by the Contractor. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total substation automation system as a whole after commissioning of total substation automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions, the test shall establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor shall rectify the problem and after rectification, the 1000 hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and employer shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the employer and then the guarantee period shall start.

12.0 **Spares**

12.1 **Consumables:**

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the owner.

12.2 **Availability Spares:**

The bidder is required to list the spares, which may be required for ensuring the guaranteed availability during the guaranteed availability period. The final list of spares shall form part of scope of supply and accordingly the price thereon shall be quoted by the bidder and shall be considered in the evaluation of the bids. During the guaranteed availability period, the spare parts supplied by the Contractor shall be made available to the Contractor for usage subject to replenishment at the earliest. Thus, at the end of availability period the inventory of spares with the Employer shall be fully replenished by the Contractor. However, any additional spares required to meet the availability of the system (which are not a part of the above spares supplied by the Contractor) would have to be supplied immediately by the Contractor free of cost to the Employer.

13.0 **LIST OF EQUIPMENTS**

Quantity of equipments shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder. The key components of the system are enumerated below.

   i) Station HMI
   ii) Redundant Station HMI (in Hot-stand by mode)
   iii) Bay level units along with bay mimic
   iv) Disturbance Recorder Work Station (Maintenance HMI)
   v) Colour Laser Printer (For Reports & Disturbance records)
vi) Dot matrix printers - (one each for Alarms and log sheets)
vii) All interface equipment for gateway to RCC and SLDC
viii) Communication infrastructure between Bay level units. Station HMI, Printers, gateways, redundant LAN etc. as required
ix) Remote workstation including HMI and along with one printer
x) Testing kit- 01 No. for two pooling stations.
xii) Any other equipment as necessary.
SYSTEM ARCHITECTURE OF THE PROPOSED SUBSTATION AUTOMATION SYSTEM:

Process/switchyard

Abbreviations:
C&R: Control & Relay
Fibre Optic Ring:
FRLS PVC Cu Control Cables:

NOTE:

i) Redundant station bus of optical fibre on IEC 61850
ii) IEDs shall be directly connected to IEC 61850 bus
iii) The general arrangement of SAS shown is illustrative only, however the bidder is required to submit typical architectural drawing of SAS
ANNEXURE-V2-P3-S2-2

NETWORK ARCHITECTURE OF THE PROPOSED SUBSTATION AUTOMATION SYSTEM:

VARIOUS DEVICES COMPUTER SYSTEM, PRINTERS, GATEWAYS, GPS HAVING DUAL 10/100 MBPS ETHERNET RJ-45 PORTS TO CONNECT TO BOTH NETWORK SWITCHES

1 Gbps Fiber Ring

220 kV Bay (1 ..n) C&R Panels

33 kV C&R Panels

Abbreviations:
Fiber CABLE:
CAT6/ ETHERNET Cables:
**Basic Monitoring requirements are:**
- Switchgear status indication
- Measurements (V, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers
- Ambient temperature
- Status and display of 415V LT system, 220V & 48V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters for inter-tripping, counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

**List of Inputs**

The list of input for typical bays is as below:-

**Analogue inputs**

i) For line
   - Current R phase
   - Y phase
   - B phase
   - Voltage R-Y phase
   - Y-B phase
   - B-R phase

ii) For transformer
   - Current R phase
   - Y phase
   - B phase
   - WTI (for transformer)
   - Tap position (for transformer)

iii) For bus coupler/Sectionalizer
   - Current R phase
   - Y phase
   - B phase

iv) Common
   - a) Voltage for Bus-I, Bus-II
      - Voltage R-Y phase
      - Y-B phase
      - B-R phase
   - b) Frequency for Bus-I and Bus-II
   - c) Ambient temperature (switchyard).
   - d) LT system
      - Voltage R-Y, Y-B, B-R of Main Switch Board section-I
      - Voltage R-Y, Y-B, B-R of Main Switch Board section-II
      - Voltage of 220V DCDB-I
      - Voltage of 220V DCDB-II
      - Current from 220V Battery set-I
Current from 220V Battery set-II
Current from 220V Battery charger-I
Current from 220V Battery charger-I
Voltage of 48V DCDB-I
Voltage of 48V DCDB-II
Current from 48V Battery set-I
Current from 48V Battery set-II
Current from 48V Battery charger-I
Current from 48V Battery charger-II

Digital Inputs
The list of input for various bays/SYSTEM is as follows:

1. Line bays

i) Status of each pole of CB, Isolator, Earth switch
ii) CB trouble
iii) CB operation/closing lockout
iv) Pole discrepancy optd
v) Trip coil faulty
vi) LBB optd
vii) Bus bar protn trip relay optd
viii) Main bkr auto recloser operated
ix) auto recloser operated
x) A/r lockout
xi) Direct trip-l/ll sent
xii) Direct trip-l/ll received
xiii) Main 1/11 blocking
xiv) Main 1/ll-Inter trip send
xv) Main 1/ll-Inter trip received
xvi) FAULT LOCATOR FAULTY
xvii) MAIN-1/11 PT FUSE FAIL
xviii) MAIN-1 PROTN TRIP
xix) MAIN-11 PROTN TRIP
xx) MAIN-1 PSB ALARM
xxi) MAIN-1 SOTF TRIP
xxii) MAIN-1 R-PH TRIP
xxiii) MAIN-1 Y-PH TRIP
xxiv) MAIN-1 B-PH TRIP
xxv) MAIN-1 START
xxvi) MAIN-1/11 inter trip
xxvii) MAIN-1/11 fault in reverse direction
xxviii) MAIN-1/11 ZONE-2 TRIP
xxix) MAIN-1/11 ZONE-3 TRIP
xxx) MAIN-1/11 weak end infeed optd
xxx) MAIN-11 PSB alarm
xxx) MAIN-11 SOTF TRIP
xxx) MAIN-11 R-PHTRIP
xxx) MAIN-11 Y-PH TRIP
xxx) MAIN-11 B-PH TRIP
xxx) MAIN-11 start
xxx) MAIN-11 inter trip
xxx) MAIN-1/11 fault in reverse direction
xli) Back-up o/c optd
xlii) Back-up e/f optd
xliii) 220V DC-I/II source fail
xliv) 48V DC-I/II source fail
xlv) SPEECH CHANNEL FAIL
xlvi) Carrier Channel-1 FAIL
xlvii) Carrier Channel-11 FAIL

2. Transformer bays
i) Status of each pole of CB, Isolator, Earth switch
ii) CB trouble
iii) CB operation/closing lockout
iv) Pole discrepancy optd
v) Trip coil faulty
vi) LBB optd
vii) Bus bar protn trip relay optd
viii) REF OPTD
ix) DIF OPTD
x) HV BUS VT 1/2 FUSE FAIL
xi) MV BUS VT 1/2 FUSE FAIL
xii) OTI ALARM/TRIP
xiii) PRD OTPD
xiv) OVERLOAD ALARM
xv) BUCHOLZ TRIP
xvi) BUCHOLZ ALARM
xvii) OLTC BUCHOLZ ALARM
xviii) OLTC BUCHOLZ TRIP
xix) OIL LOW ALARM
xx) Back-up o/c (HV) optd
xxi) Back-up e/f (HV) optd
xxii) 220v DC-I/II source fail
xxiii) TAP MISMATCH
xxiv) GR-A PROTN OPTD
xxv) GR-B PROTN OPTD
xxvi) Back-up O/c (MV) optd
xxvii) Back-up E/f (MV) optd

3. Auxiliary system
i) Incomer-I On/Off
ii) Incomer-II On/Off
iii) 415V Bus-I/II U/V
iv) 415V Bus coupler breaker on/off
vii) Communication exchange fail
viii) Time sync. Signal absent
ix) Alarm trip signals as listed in Section : Battery and Battery charger
x) 220v dc-I earth fault
xi) 220v dc-II earth fault
xii) Alarm/trip signals as listed in Section : Fire protection system(NIFPES)
The exact number and description of digital inputs shall be as per detailed engineering requirement. Apart from the above mentioned digital inputs, minimum of 200 inputs shall be kept for Nigam use in future.
TECHNICAL SPECIFICATION OF MARSHALLING KIOSKS FOR 220KV & 33KV BAYS

1.0 SCOPE:

1.01 This specification covers the design, manufacture, assembly, testing at manufacturer’s works before dispatch of Switchyard marshalling kiosk for 220/33 KV Sub-Stations. Grouting of marshalling kiosk at concerned bay shall also be in the scope of contractor.

2.0 STANDARDS:

The equipment offered should conform to relevant Indian Standards or equivalent IEC standards. The references of the relevant standard specifications wherever mentioned in the text of this specification have been given accordingly. Other authoritative standards which ensure an equal or better quality than the standards specified will also be accepted.

3.0 SPECIFICATION:

3.1 Marshalling kiosks (MKs) shall be installed out door on every 220/33 KV Pooling sub-station for marshalling the cables from equipments and other marshalling kiosks before they are taken to the control room. For this purpose, pedestal mounted outdoor type marshalling kiosks fabricated from CRCA sheet steel (not less than 2mm thick) complete with double doors & padlocking arrangement shall be supplied. The bottom of the MK’s shall be of 3mm thick CRCA sheet steel and fitted with 3mm thick gland fixing plate which shall be provided with knockouts for fixing cable glands. The MK’s shall be mounted on an angle iron frame work. Heater with ON/OFF switch, fuses and links, 3 pin 5/15 Amp plug and socket shall be provided in each kiosk. These shall bear ISI mark. The terminal block s shall be arranged in such a way that a safe working place is available for carrying out wiring etc. The wiring inside the marshalling kiosks shall be carried out with 2.5 mm Sq. PVC insulated copper wire and the kiosks shall be fitted with suitable fuses and links as necessary for the control circuit. The marshalling kiosks should have proper earthing terminals to enable earthing to be made at two places. The fuses, links of gG type is marked and terminal blocks to be provided in each MK shall be as under:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Particulars of equipment.</th>
<th>Qty. for 220 KV bays</th>
<th>Qty. for 2x33 KV bays</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HRC fuses 16 Amp.</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>HRC fuses 10 Amp.</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>HRC fuses 6 Amp.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>HRC Links</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Disconnecting type terminal blocks suitable for copper conductor (Stud size M5)</td>
<td>40</td>
<td>48</td>
</tr>
<tr>
<td>6</td>
<td>Terminal blocks suitable for copper conductor (Stud size M5)</td>
<td>200</td>
<td>48</td>
</tr>
</tbody>
</table>

3.2 Detachable canopy type cover shall be provided at the top of the M.K. detachable cover plates with gaskets shall be provided on MK’s with double doors on both side so as to enable access to the front and rear of the equipment mounting panel and the wiring.

3.3 The marshalling kiosks shall be suitable for outdoor installation and shall be so designed as to have maximum protection against indignant weather condition. It should have compact construction with a minimum degree of protection IP55 as per IS:2147. The kiosk shall be dust, and vermin proof and shall be fully protected against rain. All holes shall be blanked. The locking arrangement shall be with handle and rod such that door is closed with three points of latching (top, middle and bottom) as in case of Almirah. The hinges for the doors shall be of aluminium alloy casting with stainless steel pins so that they do not rust in the adverse atmospheric conditions to which they are subjected.

4.0 TERMINAL BLOCK:
4.1 Terminal block connectors shall be stud type of size M5 suitable for copper conductor and built from cells of moulded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the panel wiring and the corresponding incoming tail ends of control cables. Insulating barrier shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. Provision shall be made on each pillar for holding 10% extra connections. All blocks shall be shrouded by easily removable shrouds of non inflammable moulded and transparent dielectric materials.

4.2 The terminal blocks shall be suitable for 660 volts service and for connection with copper wires. Vertical MS strips should be provided between rows and ends of terminal blocks for tying the wire.

4.3 Terminal boards shall be mounted in such a manner as to afford easy access to terminations and to enable ferrule number to be read without difficulty. Wire ends shall be so connected to the terminals that no wire terminal number gets marked due to succeeding connections. In other words ferrule numbering at the terminals should be unambiguous and full proof. Terminal board rows shall be adequately spaced and shall not be less than 100mm apart so as to permit convenient access to wires and terminals. Labels in the form of engraved plastic plates shall be provided on the fixed portion of terminal boards.

4.4 No live metal parts shall be exposed at the back of the terminal boards.

4.5 All studs, nuts, bolts screws etc. shall be threaded according to the latest relevant Indian or equivalent International Standards.

5.0 HRC FUSES:

The high rupturing HRC fuses shall fully comply with and marked with the latest edition of IS: 13703 (part.I) and shall be pull-out type only. The links shall be of 1 mm thick tinned copper and fitted in fuse holders as used for the HRC fuse links. The fuses shall be of gG type/duty.

6.0 PANEL WIRING:

6.1 The kiosk's internal wiring shall be of switch board type 2.5 Sq. mm PVC insulated copper conductor suitable for 660V service and in accordance with relevant Indian Standards. Polyvinyl chloride used shall have excellent resistance against burning, moisture, oil and vermin and shall be furnished with clear colour. Rubber insulated wiring shall not be acceptable.

6.2 The wiring shall be supported by plastic cleats/PVC channels. Wires shall be terminated on to the terminal blocks with annealed and tinned (not soldered) crimp tag termination, separate termination being used for each wire, and the size of termination suited to the size of wire terminated. Wiring shall in general be accommodated on the sides of the cubicles.

6.3 Wires shall not be jointed or tied between terminated points. At the terminal connections, washers shall be interposed between terminals and holding nuts. All holding nuts shall be secured by locking nuts. The connecting studs shall be secured by locking nuts, the connecting studs shall project at least 6 mm from the lock nuts surface.

6.4 Wiring connected to the space heaters in the cubicle shall have porcelain beaded insulation over a safe length from the heater terminals. All wire shall be suitable for bending to meet the terminal studs at right angle with the studs and they shall not be skewed. Metal cases of all apparatus mounted on panels shall be separately earthed by means of flexible copper wire or strip.

7.0 FERRULES FOR PANEL WIRING:

7.1 Ferrules engraved with the same numbers, letters and symbols as indicated in the connection and wiring diagrams shall be provided on the terminal ends of all wires for easy identification of circuits for inspection and maintenance.
7.2 Ferrules shall be strong and flexible insulating material with glossy finish to prevent adhesion. They shall be engraved and clearly and durably marked and shall not be affected by dampness.

7.3 Ferrules numbering shall be in accordance with IS:375/1963. The same ferrule number shall not be used on wires in different circuits on a panel.

7.4 All points of interconnection between the wiring carried out for equipments for different suppliers, where a change of number cannot be avoided, double ferrules shall be provided on each wire with appropriate numbers on the changing end. The change of numbering shall be shown on the appropriate connection wiring diagram of the equipment.

8.0 PAINTING:

All unfinished surfaces of steel panels and frame work shall be sand blasted to remove rust, scale, foreign adhering matter and grease, a suitable rust resisting primer shall be applied on the interior and exterior surface of steel, which shall be followed by application of an under coat suitable to serve as base and binder for the finishing coat.

i) All sheet steel work shall be phosphated in accordance with IS:6005 code of practice for phosphating iron and steel.

ii) Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

iii) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with slightly alkaline hot water and drying.

iv) After phosphating thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

v) The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be “flash dried” while second coat shall be stoved.

vi) After application of primer two coats of finishing synthetic enamel paint shall be applied, each coat shall be applied followed by stoving the second coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be as per shade 631 of IS-5. The colour of the interior shall be white and the base/pedestal shall be painted black.

vii) Each of coat of primer and finished paint shall be of slightly different shade to enable inspection of painting.

9.0 SPACE HEATERS:

Tubular space heaters suitable for connection to the single phase 230 Volts A.C. supply complete with switches located at convenient positions shall be provided at the bottom of each cubicle to prevent condensation of moisture. The Watt loss per unit surface of heater shall be low enough to keep surface temperature well below visible heat. Each cubicle shall also be provided with a switch of appropriate rating for control for space heater.

A thermostat (range 30 Deg.C. to 75 Deg.C.) shall be provided in the space heater circuit for automatic control.

10.0 SWITCH BOARD LIGHTING:

The switch Board interiors shall be illuminated by incandescent lamps connected to a 230 Volts single phase A.C. Supply. The illumination of interior shall be free from hand shadows and shall be planned to avoid any strain or fatigue to the wireman who may be called upon to do work.

11.0 TITLE PLATES:

A title plate bearing the name and purpose of each marshalling kiosk shall be fixed on the either side top of each marshalling kiosk. The name of manufacturer along with month of despatch shall be indicated on the plate.
12.0  SAFETY EARTHING:

Brass earthing studs/bolts with nuts of size M12 shall be provided on both sides of the marshalling kiosk for safety earthing.

13.0  INSPECTION AND TESTS:

13.1  The following tests shall be carried out at the manufacturer’s works after complete assembling the marshalling kiosk in the presence of an Engineer.

   i) Visual inspection including verification of bill of material, general lay out of components, overall dimensions, paint, finish and overall appearance.
   ii) Checking of wiring of circuits and their continuity.
   iii) One minute 2KV insulation withstand test at 50 cycles on all equipments on the kiosks and wiring.
   iv) Insulation resistance of complete wiring, circuit by circuit with all equipments mounted on the MKs.
   v) Operation test for heater, power socket, cubical illumination etc.

13.2  TYPE TEST CERTIFICATES:

The type test certificates for IP-55 test for the cubical shall be furnished.

13.3  BOUGHT OUT ITEMS:

All the accessories, space heaters, thermostats, HRC fuse, HRC links, terminal blocks etc. shall be of “ISI MARK”. In case the space heaters, thermostat, Disconnecting type terminal and stud type terminal of under mentioned make are offered then the submission of copy of ISI/ type test certificate will not be insisted upon. The make of space heaters and thermostat are as under:

   SPACE HEATER : KAYCEE/ELTER/AIREX/PRAVEEN/SOPHIA
   THERMOSTAT : TEMPTRAL/AIREX/IRISHEGO
   DISCONNECTING TYPE TERMINAL : DAV/HEMVIN
   STUD TYPE TERMINAL : DAV/HEMVIN
TECHNICAL SPECIFICATION FOR BALL & SOCKET TYPE 11KV 45KN, 70KN & 120 KN DISC INSULATORS

1.0 SCOPE:

1.01 This section covers for the design, manufacture, testing at manufacturer’s works before despatch of Disc Insulators (Ball & Socket type). The description of insulators and string arrangements along with long rod insulators are indicated hereunder:

220 KV STRING INSULATOR UNITS (INSULATORS)

(A) INSULATOR:

(i) Type : Conventional ball & socket type.
(ii) Diameter : 255 mm.
(iii) Spacing : 145 mm.
(iv) Colour : Brown
(v) Surface : Glazed
(vi) Creepage distance : 280 mm min. for 45KN & 70 KN and 290 mm min. for 120 KN.
(vii) Ball Dia. : 16 mm for 45 KN & 70 KN and 20 mm for 120KN
(viii) Tolerance : As per relevant ISS.

(B) STRING ARRANGEMENTS:

220 KV System

<table>
<thead>
<tr>
<th>No. of Discs</th>
<th>E&amp;M Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>120 KN</td>
</tr>
<tr>
<td>2X14</td>
<td>2x120KN</td>
</tr>
<tr>
<td>13</td>
<td>70 KN</td>
</tr>
<tr>
<td>2x13</td>
<td>2x70KN</td>
</tr>
</tbody>
</table>

(e) Min. failing load: As above & relevant ISS.
(f) All Electrical & Mechanical values of string: Confirming to Highest System voltage 245KV in Table-1A of IS:731-1971(with latest amendments)

(C) LONGROD INSULATORS

(i) Type : Conventional Ball & Socket type.
(ii) Colour : Brown
(iii) Surface : Glazed
(iv) Creepage distance : 3800 mm for 220 kV (min) normal LRI
(v) Double ended Ball : 16 mm for 45 KN & 70 KN, 20 mm for 120 KN.
(vi) Tolerance : As per relevant ISS
(vii) All Electrical & mech. values of string: Conforming to highest system voltage 245 KV in Table-1A of IS:731-1971 (with latest amendments).

2.0 STANDARDS

The insulator strings and its components shall conform to the relevant Indian Standards/International standards which shall mean latest revisions, with amendments/changes adopted and published, unless otherwise stated in the specification. The relevant standards shall include the following:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS: 731</td>
<td>Specification for Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 volt.</td>
</tr>
<tr>
<td>IS:2486 (Part-1)</td>
<td>Metal fitting of insulator for overhead power lines with a nominal voltage greater than 1000 volt - Specification, General requirements &amp; tests</td>
</tr>
</tbody>
</table>
3.0 MATERIALS, DESIGN & TYPE:

3.1 All the materials used in the manufacture of the insulators shall be of the first class quality. The porcelain shall be sound, free from defects thoroughly vitrified and smoothly glazed.

3.2 The glaze shall be brown in colour. The glaze shall cover all the porcelain part of the insulator except those areas which serve as supports during fitting or are left unglazed for the purpose of assembly. The glaze shall be uniform, smooth, hard, dense, continuous and brilliant.

3.3 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.

3.4 Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible. Proper care shall be taken to correctly center and locate individual parts during cementing.

3.5 All parts of different fittings which provide for interconnection shall be made such that sufficient clearance is provided at the connection point to ensure free movement and suspension of the insulator string assembly. All ball and socket & connections shall be free in this manner but care shall be taken that too much clearance is avoided.

3.6 All hardware fittings (except those specified otherwise) shall be made of drop forged steel or heat treated malleable cast iron, and shall be hot dip galvanized after all machining and fittings have been completed. The material used in fittings shall be corrosion resistant.
3.7 The locking devices shall be resilient, corrosion resistant & of suitable mechanical strength. The hardness and temper of the material are important for their satisfactory operation. The locking devices shall retain their locking ability after being operated from the locking to the coupling position at least twenty times, at normal temperature. They should be effective at the lowest temperature likely to be encountered in service.

3.8 For Ball & Socket type disc insulators, the cap and the pin shall be heavily galvanized and mechanically strong. The ball shall move freely in the cap sockets, but shall be so designed that they do not give way while in service. The dimensions of the pin, ball & socket shall be conforming to ISS 2486/part-II. The cap shall be made of malleable cast iron confirming to IS:2108-1977 or Cast Iron containing spheroidal graphite conforming to IS: 1865-1974. These shall be free from cracks, shrinks, air holes, burs and rough edges. The caps shall be circular, with inner and outer surfaces concentric and of such design that they will not yield or distort under the stress to the porcelain shells. The pin shall be single piece made of drop forged steel and shall be free from laps, field’s burs and rough edges. All bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. The pins shall be of such a design that they will not yield or distort under loaded condition. They shall not be made by joining, welding, shrink fitting or any other process from more than one piece of material. The locking devices 'W/R' type for Ball & Socket lockers shall be either of Phosphor bronze confirming to IS:7814-1975 or stainless steel confirming to IS:6603-1972 with minimum hardness of 160 HV. The dimensions shall conform to IS:2486 (Part-3)-1974.

3.9 The design of long rod insulators shall be such that stresses due to expansion & contraction in any part of insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.

3.10 The dimensions of pin ball socket shall be according to figure 8 & 9 respectively of IS:2486 Part-II/1989) IInd revision.

4.0 CLASSIFICATION SIZE & NO. OF DISCS:

4.1 The insulators shall be of type-B as specified under clause-5 "Classification" of IS:731-1971 (second revision).


5.0 TESTING:


5.2 TEST VOLTAGE:

The test voltage of the insulators shall be as given here under (values given are without applying correction factors):

DISC & PORCELAIN LONGROD INSULATORS FOR USE ON 220 KV LINES:

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Highest System Voltage</td>
<td>245 KV (rms)</td>
</tr>
<tr>
<td>3. Visible Discharge Test</td>
<td>154 KV (rms)</td>
</tr>
<tr>
<td>(Power Frequency Voltage)</td>
<td></td>
</tr>
<tr>
<td>4. Wet Power Frequency Withstand Test</td>
<td>395 KV (Rms)</td>
</tr>
</tbody>
</table>
5. Impulse Voltage Withstand Test : 900 KV (Peak)
6. Power Frequency : 1.3 Times the Actual Dry Flash over voltage of the unit.
7. Min. Creepage Distance of the Insulator String for moderately Polluted Atmosphere. : 3800 mm (Min.)
8. Earthing : Solidly Earthed
9. Conductor : AL-59 (Moose equivalent)
10. Stranding & Wire/Diameter : 61/3.50 mm
11. Approx. Overall Diameter : 31.50 mm
12. Approx. Calculated Breaking Load : 14112.00 Kg.
13. Approx. Total mass : 1618 Kg/ Km

However, ACSR Tarantulla (Single/ Double) conductor shall be used for 33kV buses and the detailed technical parameters shall be provided at the time of supply.

6.0 MECHANICAL LOADS:

The insulator strings shall be suitable for the minimum failing loads specified in Table -2 Clause 7 of IS:731/ 1971 (IInd Revision).The load shall be supplied axially to the insulator strings.

7.0 MARKINGS: Each insulator shall be legibly and indelibly marked to show the following:

(a) Name or trade mark of the manufacturer.
(b) Batch No., Month and year of manufacture.
(c) Minimum failing load in KN.
(d) Country of manufacture.

Insulators may also be marked with the certification mark.

8.0 TYPE TESTS:

Type tests are intended to prove conformity of the general qualities and design of the insulators with the requirement of specification. An insulator subjected to type tests may be unsuitable for subsequent use in service. Type test shall be made on insulator that has passed the routine test.

Type test certificates for single disc, LRIs & strings, giving the results of type tests shall be furnished. Drawing number of product should also be mentioned in the type test certificates and that drawing should be attested by the Testing authority.

The type tests have been segregated in two parts ‘Essential Type Test’ & ‘Additional Type Test’. The bidder is required to furnish the type tests covered under essential category from a Govt./Govt. approved/ Govt. recognized/ NABL Accredited lab/ILAC i.e. International Laboratory Accrediation Cooperations (in case of foreign laboratory). Such type test certificate should not be older than 7 years as on the date of bid opening. For this purpose date of conducting type test will be considered.

The type test certificate from in house laboratory of tendering firm, even if it is a Govt. approved/ Govt. recognized/ NABL accredited/ ILAC accredited shall not be accepted in case of their own tender. This will not apply if tendering firm is Govt. company/ Public Sector Undertaking.

9.0 The following shall constitute essential type test:
9.1 On each type of disc Insulators:

<table>
<thead>
<tr>
<th>(a)</th>
<th>Verification of dimensions</th>
<th>IEC:383</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b)</td>
<td>Power frequency voltage withstand and flashover Test (i) dry (ii) wet</td>
<td>---do---</td>
</tr>
<tr>
<td>(c)</td>
<td>Impulse voltage withstand and flashover test (dry)</td>
<td>---do---</td>
</tr>
<tr>
<td></td>
<td>Test Description</td>
<td>Standard</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>(d)</td>
<td>Visible Discharge test (dry)</td>
<td>IS:731</td>
</tr>
<tr>
<td>(e)</td>
<td>Temperature cycle test</td>
<td></td>
</tr>
<tr>
<td>(f)</td>
<td>Electro mechanical failing load test</td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td>Twenty four hours mechanical strength test or Mechanical Performance Test</td>
<td></td>
</tr>
<tr>
<td>(h)</td>
<td>Puncture test</td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Porosity test</td>
<td></td>
</tr>
<tr>
<td>(j)</td>
<td>Galvanising test</td>
<td></td>
</tr>
</tbody>
</table>

9.2 On Porcelain Long rod Insulator Units:

<table>
<thead>
<tr>
<th></th>
<th>Test Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Verification of dimensions</td>
<td>IEC:383</td>
</tr>
<tr>
<td>(b)</td>
<td>Power frequency voltage withstand and flashover Test (i) dry (ii) wet</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Impulse voltage withstand and flashover test (dry)</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Visible Discharge test (dry)</td>
<td>IS:731</td>
</tr>
<tr>
<td>(e)</td>
<td>Temperature cycle test</td>
<td></td>
</tr>
<tr>
<td>(f)</td>
<td>Mechanical failing load test</td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td>Porosity test</td>
<td></td>
</tr>
<tr>
<td>(h)</td>
<td>Galvanising test</td>
<td></td>
</tr>
</tbody>
</table>

9.3 On complete Disc Insulator String with Hardware Fittings:

<table>
<thead>
<tr>
<th></th>
<th>Test Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Visible discharge test</td>
<td>IS:731</td>
</tr>
<tr>
<td>(b)</td>
<td>Lightening Impulse voltage withstand test under dry condition</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Power frequency voltage withstand test with arcing horns under wet conditions.</td>
<td></td>
</tr>
</tbody>
</table>

9.4 On complete Porcelain Long rod Insulator String with Hardware Fittings:

<table>
<thead>
<tr>
<th></th>
<th>Test Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Visible discharge test</td>
<td>IEC: 433, IS:731</td>
</tr>
<tr>
<td>(b)</td>
<td>Lightening Impulse voltage withstand test under dry condition</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Power frequency voltage withstand test with arcing horns under wet conditions.</td>
<td></td>
</tr>
</tbody>
</table>

In 2nd category, the bidder is required to furnish additional type test of each type of disc insulators and also on complete disc insulator string with hardware fitting. The additional tests be got carried out on the 1st offered lot at the works of the bidder in the presence of inspecting officer and in case the facilities are not available at their works then in some Govt. approved/ Govt. recognised/ Govt. Accredited laboratory on the samples selected by the inspecting officer from the 1st lot.

9.5 The following shall constitute the additional type tests:

9.5.1 On each type of disc insulators:

<table>
<thead>
<tr>
<th></th>
<th>Test Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Thermal Mechanical performance test</td>
<td>As given in clause 14</td>
</tr>
<tr>
<td>b)</td>
<td>Residual strength test</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Steep Wave Front Test</td>
<td></td>
</tr>
</tbody>
</table>
9.5.2 On Porcelain Longrod Insulator Units:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Thermal Mechanical performance test</td>
</tr>
<tr>
<td></td>
<td>As given above</td>
</tr>
</tbody>
</table>

9.5.3 On complete disc insulator string with Hardware fittings:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Impulse voltage flashover test under dry condition</td>
</tr>
<tr>
<td>b)</td>
<td>Voltage distribution test</td>
</tr>
<tr>
<td>c)</td>
<td>Mechanical strength test</td>
</tr>
<tr>
<td>d)</td>
<td>Vibration test</td>
</tr>
<tr>
<td></td>
<td>As given in clause 14</td>
</tr>
</tbody>
</table>

9.5.4 On complete Porcelain Long rod Insulator String with Hardware Fittings:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Impulse voltage flashover test under dry condition</td>
</tr>
<tr>
<td>b)</td>
<td>Mechanical strength test</td>
</tr>
<tr>
<td>c)</td>
<td>Vibration test</td>
</tr>
<tr>
<td></td>
<td>As given in IEC-383</td>
</tr>
</tbody>
</table>

10.0 ACCEPTANCE TESTS:

These tests shall be for the purpose of acceptance of the lot. For carrying out acceptance test sampling procedure given in Appendix ‘C’ of IS: 731/1971 (with latest revision) shall be followed. The sample size for longrod insulators shall be in accordance with IEC-383 (part.I) and $E_1$ & $E_2$ shall be 4 & 3 respectively for lot size less than 300 numbers.

The insulators selected shall be divided approximately into three parts and subjected to the tests in the order as specified in clause No. 10.1.2.2. of IS: 731/1971.

The insulators after having withstood the routine tests shall be subjected to the acceptance tests.

10.1 For Disc Insulators:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Visual examination</td>
</tr>
<tr>
<td>(b)</td>
<td>Verification of dimensions</td>
</tr>
<tr>
<td>(c)</td>
<td>Temperature cycle test</td>
</tr>
<tr>
<td>(d)</td>
<td>Electro mechanical failing load test</td>
</tr>
<tr>
<td>(e)</td>
<td>Twenty four hours mechanical strength test</td>
</tr>
<tr>
<td>(f)</td>
<td>Puncture test</td>
</tr>
<tr>
<td>(g)</td>
<td>Porosity test</td>
</tr>
<tr>
<td>(h)</td>
<td>Galvanising test</td>
</tr>
</tbody>
</table>

10.2 For Porcelain Long rod Insulators:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Visual examination</td>
</tr>
<tr>
<td>(b)</td>
<td>Verification of dimensions</td>
</tr>
<tr>
<td>(c)</td>
<td>Temperature cycle test</td>
</tr>
<tr>
<td>(d)</td>
<td>Mechanical failing load test</td>
</tr>
<tr>
<td>(e)</td>
<td>Porosity test</td>
</tr>
<tr>
<td>(f)</td>
<td>Galvanising test</td>
</tr>
</tbody>
</table>

11.0 ROUTINE TESTS:

11.1 For Disc Insulators:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Visual Inspection</td>
</tr>
<tr>
<td>(b)</td>
<td>Mechanical routine test</td>
</tr>
<tr>
<td>(c)</td>
<td>Electrical routine test</td>
</tr>
</tbody>
</table>

11.2 For Porcelain Long rod Insulator Units:
Routine tests shall be carried out on each insulator & to check requirements which are likely to vary during production as per relevant ISS (with latest amendments).

12.0 PACKING:

All insulators shall be packed in suitable crates or boxes with suitable steel bands so as to withstand rough handling and storage at destination. The gross weight of packing shall not exceed 50 Kgs.

13.0 DRAWINGS:

The drawings showing design and dimensions shall be furnished. The type of the material used for various parts shall be clearly specified on the drawing.

14.0 PROCEDURES FOR TESTING ON PORCELAIN INSULATORS:

14.1 Tests on Complete Strings with Hardware Fittings:

14.1.1 Voltage Distribution Test:

Voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted in to percentage. The voltage across any disc shall not exceed 13% to 15% in respect of 220KV Suspension & Tension Strings.

14.1.2 Mechanical Strength Test:

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

14.1.3 VIBRATION TEST:

The suspension string shall be tested in suspension mode and tension string in tension mode itself in laboratory test span of minimum 30 meters. In the case of suspension string, a load equal to 600 kg. shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and single insulator tensioned at 35 KN in case of 220KV String Arrangements shall be secured with clamps. The system shall be suitable to maintain constant tension on the insulator throughout the duration of the test. Vibration dampers shall not be used on the test span. The insulator shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinodes point, nearest to the string, shall be measured and the same shall not be less than 1000/f1.8 where f is the frequency of vibration in cycles/ second. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness, fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and insulators after the vibration test. The insulators shall be subjected to the following tests as per relevant standards:
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Tests</th>
<th>Percentage of insulator units to be tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Temperature cycle test followed by mechanical performance test</td>
<td>60</td>
</tr>
<tr>
<td>b.</td>
<td>Puncture test</td>
<td>40</td>
</tr>
</tbody>
</table>

14.2 On Insulator Units:

14.2.1 Steep Wave Front Test:

The following test shall be performed on 10 insulator units in case of disc insulators selected at random from the lot offered for selection of sample for type test.

(a) Each insulator unit shall be subjected to five successive positive and negative impulse flashovers with a wave having minimum effective rate of rise of 2500 KV per microsecond.

(b) Each unit shall then be subject to three dry power frequency voltage flashovers.

Acceptance Criteria:

An insulator shall be deemed to have met the requirement of this test if, having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry/power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage.

An insulator shall be deemed to have failed to meet the requirement of above testing if,

(a) It has not flash over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.

Or

(b) Any one of the subsequent three dry power frequency voltage flashover value is less than 80% of the value specified.

Failure of any unit either in the steep wave front or subsequent low frequency voltage test shall cause for testing on double number of units.

14.2.2 Thermal Mechanical Performance Test:

Thermal Mechanical Performance Test shall be performed in accordance with IEC-383-1-1993 clause 20 with the following modifications:

(1) The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.

(2) The acceptance criteria shall be:

(a) $X \geq R + 3S$, where $X$ Mean value of the individual mechanical failing load.

   \[ R \text{ - Rated electro-mechanical/mechanical failing load} \]

   \[ S \text{ - Standard deviation.} \]

(b) The minimum sample size shall be taken as 20 for disc insulators and 5 for Long rod Insulators.

(c) The individual electro-mechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

14.2.3 Electromechanical/Mechanical failing Load Test:

This test shall be performed in accordance with clause 18 and 19 of IEC-383 with the following acceptance:
(i) $X \geq R + 3S$, where $X$ Mean value of the electro-mechanical/mechanical failing load.
R- Rated electro-mechanical/mechanical failing load
S- Standard deviation

(ii) The minimum sample size shall be taken as 20 for disc insulators and 5 for Long rod Insulators. However, for larger lot size, IEC 591 shall be applicable.

(iii) The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

14.2.4 Residual Strength Test:

The above test shall be performed as per clause 4.4 and 4.5 of IEC-797 preceded by the temperature cycle test, on porcelain disc insulators. The sample size shall be 25 and the evaluation of the results and acceptance criteria shall be as per clause No. 4.6 of IEC:797.
1.0 SCOPE:

This specification covers the design, manufacture, testing at manufacturer’s works before despatch of hardware clamps & connectors suitable for use at RSDCL’s 220/33 KV Park Pooling Sub-stations proposed to be constructed at Nokh, Jaisalmer.

2.0 STANDARDS:

The hardware clamps & connectors should conform in all respect to the latest editions of IS-2486 Part I to IV and power connectors to IS:5561/1970. All nuts shall be made of material conforming to IS: 5561/1970. All nuts shall be made of material conforming to property clause 4.8 of IS:1367/1980 (Pt.VI) (2nd revision) with regard to its mechanical properties. Cotter pins should be made of forged steel conforming to clause 2 of IS:2004/1991 (3rd revision) with latest amendments. All ferrous parts shall be hot dip galvanized. Electro galvanized ferrous fittings shall be checked in accordance with IS:1573/1986 with latest amendment. The hardware fittings are required to be used with Disc Insulators string units containing insulators of type-B as classified under clause 5 “Classification” of IS:731/1971 with latest amendment and conductors as per relevant IS.

3.0 HARDWARE CLAMPS & CONNECTORS:

3.1 GENERAL REQUIREMENTS:

(i) The insulator string Hardware Clamps & Connectors shall be supplied complete in all respect and shall include all fittings necessary for composing the insulator strings and should include U-shackles, clevis or ball-links for attaching it to the strain plate or hangers supplied with Sub-Station structures. Conductor suspension or strain clamps should be suitable for attaching the specified conductor to the string.

Suspension Hardware Clamps & Connectors shall be suitable for ball & socket type interconnection between top and bottom parts to be used with B&S type disc insulators with 16mm dia ball pin and tension hardware with B&S type disc insulators of 20 mm dia ball pin. In case of double suspension and double tension strings, hardwares shall also include suitable yoke attachment.

The supplier shall ensure that the insulator fittings offered are complete in all respect and are entirely suitable for the proposed attachment and for the sizes of conductors indicated below.

All Bolts, nuts & screw heals shall be of with worth standard thread. Bolt heads and nuts shall be hexagonal. Wherever required, nuts shall be locked in an approved manner. The threads in nuts and tapped holes shall be cut after galvanizing and shall be well lubricated or greased. All other threads shall be cut before galvanizing. The bolt thread shall be undercut to take care of increase in diameter due to galvanization.

(ii) All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as at the eye clevis and holes, shall be rounded.

(iii) All parts of different fittings which provide for interconnection shall be made such that sufficient clearance is provided at connection point to ensure free movement and suspension of the insulator string assembly. All eye and clevis connections shall be free in this manner but care shall be taken that too much clearance between eye and tongues of the clevis is avoided.

3.2 MATERIAL DESIGN AND TYPE:

(i) The material for string insulator fittings (except those specified otherwise) shall be either drop forged steel or heat treated malleable cast iron and shall be hot dip galvanised after
all machining and fittings have been completed. The material used in fittings shall be corrosion resistant. All nuts shall be made of material conforming to property clause 4.8 of IS: 1367-1980 (Part-II) (2nd revision) with regard to its mechanical properties and cotter pins shall be made of forged steel conforming to clause 2 of IS-2004-1991(3rd revision) with latest amendments.

The security clips shall be of phosphor bronze conforming to IS: 1385/1968 or of brass of suitable temper with minimum hardness of 100 HV conforming to IS: 410-1967 (second revision) with latest amendments. For galvanizing, zinc conforming to grade Zn 98 of IS:209/1966 shall be used.

(ii) The locking devices shall be resilient, corrosion resistant and of suitable mechanical strength. The hardness and temper of the material are important for their satisfactory operation.

The locking devices shall retain their locking ability after being operated from the locking to the coupling position atleast twenty times, at normal temperature. They should be effective at the lowest temperature likely to be encountered in service.

All fittings shall be designed so that the harmful bimetallic corrosion is avoided and effects of vibration both on conductor and fitting itself are minimized.

3.3 SUSPENSION CLAMPS:

The Bolted type suspension clamps offered shall be made of high strength aluminium alloy and shall be suitable for use with conductor indicated above. The composition of the alloy shall be declared by the tenderer giving reference to the relevant ISS. The design of clamps shall be such that the effects of vibration both on the conductor and fitting itself are minimized. Sharp radial of curvature, ridges etc. which might lead to localized pressure or damage to the conductor in service, shall be avoided. The clamps shall permit the conductor to slip before the failure of the conductor occurs and shall have a sufficient slipping strength to resist conductor tension under broken wire condition. The suspension clamps shall also be provided with suitable socket or clevis eye (made of drop forged steel or cast iron) for connecting it to the insulator string. The fittings shall have sufficient contact surface to minimise damage due to fault currents.

3.4 TENSION CLAMP:

The bolted type clamps shall be made out of high strength aluminium alloy suitable for conductor indicated above. The mechanical efficiency of tension clamps shall not be effected by method of erection involving "Come- Along" or similar clamp during or after assembly and erection of tension clamp itself. The strain clamp shall have the same conductivity as the conductor, and shall be of a design that will ensure unrestricted flow of current.

4.0 POWER CONNECTORS:

4.1 MATERIALS:

All materials used shall conform to the relevant ISS. All aluminium and aluminium alloy used in the manufacture of the connector shall conform to designation A6 of IS:617(1975) Latest amended and IS:1367 (latest amended). Non-ferrous alloy bolts, nuts and spring washers shall conform to the relevant Standards.

4.2 DIMENSIONS AND TECHNICAL REQUIREMENTS:

The contractor shall submit the dimensional drawings of various types of clamps and connectors suitable for AL-59 (Moose equivalent) and Tarantulla conductors required for pooling sub-stations for approval.
220 KV STRING INSULATOR HARDWARE

1. Power system                  220KV, 3Phase 50 Cycles Effectively earthed.
2. Insulators:
   Type                            Conventional B&S type
   Diameter                     255 mm
   Spacing                       145 mm
   Colour                         Brown
   Surface                        Glazed

3. Strings arrangements

<table>
<thead>
<tr>
<th>Nos. of Discs</th>
<th>Electromechanical Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>220 KV</td>
<td>220 KV</td>
</tr>
<tr>
<td>(a)</td>
<td>Suspension strings for normal suspension location. 13 70 KN</td>
</tr>
<tr>
<td>(b)</td>
<td>Tension strings for normal tension locations 14 120 KN</td>
</tr>
<tr>
<td>(c)</td>
<td>Double suspension strings for special location. 13x2 2x70 KN</td>
</tr>
<tr>
<td>(d)</td>
<td>Double tension strings for special locations. 14x2 2x120 KN</td>
</tr>
<tr>
<td>(e)</td>
<td>Minimum Failing load. As above &amp; relevant ISS</td>
</tr>
</tbody>
</table>

4. Accessories & Hardwares for 220 KV Power Conductor Hardwares shall meet the requirement of slip strength and ultimate strength and minimum failing load.

220 KV STRING INSULATOR HARDWARES:

1. Power system                  220 KV, 3 Phase, 50 cycle, effectively earthed
2. Highest system voltage                               245 KV(rms)
3. Visible discharge test (power frequency voltage) 154 KV(rms)
4. Wet power frequency withstand test            395 KV(rms)
5. Impulse voltage Withstand test                  900 KV(Peak)
6. Power frequency puncture withstand voltage 1.3 times the actual dry flashover voltage
7. Minimum creepage distance of the Insulator for moderately polluted atmosphere (total) 3800 mm.

4.1 GENERAL REQUIREMENTS:

The power connectors shall be smooth and free from cavities, blow-holes and other defects and such adverse effects like sharp radii of curvature, ridges & excrescence which might lead to localised pressure or damage to conductor in service. Power connectors shall be so designed and proportioned that they are capable of safely withstanding stresses to which they may be subjected (including these due to short circuit and climatic conditions) and that the effect of vibrations, both on the conductor and the connector itself are minimized. Sufficient contact pressure should be maintained at the joint by the provision of the required number of bolts or other fixing arrangements, but the contact pressure should not be so great as to cause relaxation of the joint by coil blow. The joint should be such that the pressure is maintained within the range under all conditions of service. To avoid excessive local pressure, the contact pressure should be evenly distributed by the use of pressure plates, washers or suitable saddles of adequate area and thickness.

4.2 RATINGS:

(a) Rated current: The rated current of power connectors and clamps shall be as per the type of conductor used for substation works.
(b) Rated frequency of the power connectors shall be 50Hz.
3.61

Rated Short Time Current: Rated short time current (rms) for one second of the power connectors shall be as under:

Connectors Suitable for 36kV system - 31.5 KA
Connectors Suitable for 245kV system - 40.0 KA

4.3 LIMITS OF TEMPERATURE RISE:

The limits of temperature rise specified are based on the following reference ambient temperatures:

(a) Maximum ambient air temp.=50 Deg. C
(b) Maximum daily average ambient temp.=32.5 Deg. C
(c) Maximum Yearly average ambient temp.=32.0 Deg. C

The temperature rise of power connectors above a reference ambient temperature of 40 Deg. C. when carrying rated current as above shall not exceed 45 Deg. C to fulfill the requirement of Clause 6IS:5561 (1970).

4.4 PROTECTION AGAINST CORROSION:

All parts of the power connectors shall either be inherently resistant to atmospheric corrosion or suitably protected against corrosion, both during storage and in service. All ferrous metal parts intended for outdoor use, except those made of stainless steel shall be protected by hot-dip galvanizing in accordance with IS:2633(1986). The threads of nuts and tapped bolts shall be cut after galvanizing and shall be well oiled or greased. All other threads shall be cut before galvanizing.

5.0 TYPE TEST CERTIFICATES:

The tenderer must furnish certified photocopies of test reports for all type test specified in the latest editions of relevant ISS which should be from Govt./Govt. recognized/Govt. accredited/NABL accredited laboratories/ILAC i.e. International laboratory Accreditation cooperation (in case of foreign laboratory). The drawing No. of the samples on which type tests were conducted should be clearly stated in the test report. A copy of the relevant detailed drawing indicating material, dimensions, weight etc. and duly signed and stamped by the testing authority should also be enclosed with the test report. The following type test reports shall be furnished.

5.1 Suspension Hardware Clamp:

(a) Visual examination test
(b) Verifications of dimensions
(c) Slip strength test] IS: 2486 (Part.I/1993)
(d) Galvanising test/Electroplating test
(e) Ultimate Strength test/Mechanical) with latest amendment
   Strength test
(f) Chemical composition test (on fitting)

5.2 On Tension Hardware Clamp:

(a) Visual examination test
(b) Verifications of dimensions
(c) Slip Strength test] IS: 2486 (Part.I/1993)
(d) Ultimate Strength Test / Mechanical Strength Test with latest amendment
(e) Galvanising test/Electroplating test
(f) Chemical Composition test (on fitting)

5.3 Flexible Copper Earth bond:

(a) Visual examination
5.4 Earthwire Tension Clamp Assembly:

(a) Visual examination  
(b) Verification of dimension  
(c) Electrical resistance test  | IS: 2121 (Part.III/1992)
(d) Mechanical strength test  | with latest amendment
(e) Chemical composition test  
(f) Galvanising test  

5.5 T Clamp, PG Clamp, PI Clamp, Solid Bus Bar Spacer & T Spacer:

(a) Visual examination test  
(b) Verification of dimension  
(c) Tensile test  | IS: 5561 (1970)
(d) Resistance test (except PI clamp)  | with latest amendment
(e) Temperature rise test (except PI clamp)  
(f) Short time current test (except PI clamp)
(g) Galvanising/Electroplating test  

6.0 ACCEPTANCE TEST

6.1 On both Suspension & Tension Hardware Clamps:

(a) Visual examination  
(b) Verification of dimension  
(c) Ultimate Strength test/Mechanical Strength test  | IS: 2486 (Part.I/1993)
(d) Slip strength test  | with latest amendment
(e) Chemical composition test  
(f) Galvanising/Electroplating test  

6.2 Flexible Copper Earth bond:

(a) Visual examination  
(b) Verification of dimension  | IS: 2121 (Part.III/1992)
(c) Chemical composition test  | with latest amendment

6.3 Earthwire Tension Clamp Assembly:

(a) Visual examination  
(b) Verification of dimension  
(c) Mechanical strength test  | IS: 2121 (Part.III/1992)
(d) Chemical composition test  | with latest amendment
(e) Galvanising test/Electroplating test  

6.4 T Clamp, PG Clamp, PI Clamp, Solid Bus Bar Spacer & T Spacer

(a) Visual examination test  
(b) Verification of dimension  
(c) Tensile test  | IS: 5561 (1970)
(d) Resistance test (except PI clamp)  With latest amendment
(e) Galvanising/Electroplating test  

7.0 Routine tests:

Test shall be carried out on each item & to check requirements which are likely to vary during production as per relevant ISS (with latest amendment).
TECHNICAL SPECIFICATION OF VARIOUS STEEL SECTIONS

1.0 SCOPE:-

1.1 This specification provides for manufacture, testing, inspection & testing before despatch of M.S. Rods, Flat & Channel for use in structural work and earthing purposes.

1.2 Steel sections shall also be suitable for welded, bolted and riveted structures and for general engineering purposes and conform to IS-2062.

1.3 Where welding is employed for fabrication and guaranteed weld ability is required, welding procedure should be as specified in IS:9595/1980 and steel section shall conform to IS:2062 latest edition.

2.0 STANDARDS

Except as modified in this specification, the material, and purpose of material covered under "SCOPE" clause 1.1 to 1.3 shall confirm to the latest revision with amendments thereof of the following bureau of Indian Standards:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Bureau of Indian Standards &amp; IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>2062</td>
<td>Steel for General Structural Purpose (5th Revision)</td>
</tr>
<tr>
<td>2)</td>
<td>228</td>
<td>Method of Chemical Analysis of Steel (2nd Revision)</td>
</tr>
<tr>
<td>3)</td>
<td>1608/1995</td>
<td>Mechanical testing of metals: - Tensile Testing (Second Revision)</td>
</tr>
<tr>
<td>4)</td>
<td>3803 Part.I/1989</td>
<td>Steel-Conversion of elongation Values Part.I Carbon &amp; alloy Steels (Second Revision)</td>
</tr>
<tr>
<td>5)</td>
<td>8910/1978</td>
<td>Ground technical delivery requirements for steel &amp; steel products.</td>
</tr>
<tr>
<td>6)</td>
<td>10842/1984</td>
<td>Testing &amp; evaluation procedure for Y groove crackability test.</td>
</tr>
<tr>
<td>7)</td>
<td>1599/1985</td>
<td>Method for bend test (second revision)</td>
</tr>
<tr>
<td>8)</td>
<td>1852/1985</td>
<td>Rolling and cutting tolerances for hot rolled steel products (Third Revision)</td>
</tr>
</tbody>
</table>

3.0 MATERIAL

3.1 The steel sections shall conform to following:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Grade Designation</th>
<th>Relevant IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Steel for general structural purpose</td>
<td>Fe 410 WA</td>
<td>2062</td>
</tr>
</tbody>
</table>

3.2 The steel sections manufactured from billets of only the prime producers shall be accepted. However, if it is observed below standard, the particular lot may be rejected. Bidder shall make his own arrangements for the procurement of the steel billets (only of prime producers) from which the steel sections are to be manufactured.

3.3 The raw material i.e. billets, for manufacturing of steel sections shall be stocked in adequate quantity by the bidder to ensure that the progress of the work is not jeopardised.

4.0 GENERAL TECHNICAL REQUIREMENT

The Technical parameters to which the steel sections shall confirm are as under:

4.1 Steel for Structural Purpose:

   (i) Mechanical properties:
(a) Grade                                   A  
(b) Designation                            Fe 410 W A  
(c) Tensile strength min., mpa         410  
(d) Yield strength min.,:               <20mm;  20-40mm;  >40mm  
                                           250,   240,   230  
(e) Elongation percent, min              23  
(f) Internal Diameter of Bend min.       3t  

(ii) Chemical composition:  
(a) Grade                                   A  
(b) Designation                                  Fe 410 W A  
(c) Ladle Analysis, percent, Max.  
                                           C   0.230  
                                           Mn  1.500  
                                           S   0.045  
                                           P   0.045  
                                           Si  0.400  

(d) Supply condition.                        As rolled.  
(e) Carbon equivalent (CE), Max.            0.42  
(f) De-oxidation mode                      Semi killed or killed  

4.2 Mass & Standard length:  

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Item</th>
<th>Mass in Kg/metre</th>
<th>Standard length</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M.S. Rod</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Size 40mm</td>
<td>9.85</td>
<td>not less than 6 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td></td>
<td>(b) Size 28mm</td>
<td>4.83</td>
<td>not less than 6 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td></td>
<td>(c) Size 25mm</td>
<td>3.85</td>
<td>not less than 6 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td>2.</td>
<td>M.S. Flat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Size 75x12mm</td>
<td>7.07</td>
<td>not less than 10 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td></td>
<td>(b) Size 50x12mm</td>
<td>4.71</td>
<td>not less than 10 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td></td>
<td>(c) Size 50x10mm</td>
<td>3.93</td>
<td>not less than 10 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td></td>
<td>(d) Size 50x6mm</td>
<td>2.36</td>
<td>not less than 10 Meters</td>
<td>Fe410WA</td>
</tr>
<tr>
<td>3.</td>
<td>G.I. Channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Size 100x50mm</td>
<td>ISMC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3 Rolling and cutting Tolerances:      As per IS 1852

4.4 Packing & Marking:  

Packing : As per IS.  
Marking : The Steel sections shall be marked with colour code as per IS and name of the manufacturer duly embossed during manufacturing.  

4.5 Workmanship:  

(i) All finished steel shall be well and clearly rolled to dimensions, sections and masses specified. The finished material, shall be reasonably free from surface flows, laminations, rough/jagged and Imperfect edges and other harmful defects.  

(ii) Minor surface defects may be removed by the manufacturer.
5.0 TESTS

Before dispatch, the various Steel sections shall be subjected to the following tests at maker’s Works as per IS:2062 latest amended.

ROUTINE TEST/ ACCEPTANCE TEST:

1. Dimensional Checking & Visual Inspection.
2. Weight Checking
3. Chemical Composition Test
4. Mechanical Properties Tests

6.0 INSPECTION

6.1 All the tests (as mentioned at Clause 5.0) and Inspection shall be made at the place of manufacturer. The bidder shall provide all reasonable facilities without charges to the inspecting officer(s) representing the purchaser, to satisfy him that the material is being furnished in accordance with this specification. The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is a dispute regarding the quality of supply.

The Inspection may be carried out by the purchaser at any stage of manufacture/ before despatch as per relevant standard.

Inspection and acceptance of any material under the specification by the purchaser shall not relieve the bidder of his obligation of furnishing material in accordance with the specification and shall not prevent subsequent rejection if the material is found to be defective. The Bidder shall keep the purchaser informed in advance, about manufacturing programme so that arrangements can be made for inspection.

6.2 IDENTIFICATION & MARKING:

6.2.1 Each product shall carry a tag or be marked with the name or trade mark of the manufacturer. Designation of Steel should also be marked on the product tag.

6.2.2 The ends of the rolled product shall be painted with a colour code "Green" for Grade ‘A’ and as per relevant IS.

7.0 PACKING & FORWARDING

The various sections of steel shall be packed in such a manner so that same should be able to resist hazard involved in transportation, unloading, stacking etc.
1. The details (For tender purpose only) of laying of earthmat at Pooling Stations is enclosed at Annexure-“a” of Section-III of this volume. However, the contractor will develop the detailed drawing (supported with calculations) for laying of earthmats at Pooling Stations as per system requirement and fulfilling the provisions of Electricity Act and will submit the same to RSDCL for necessary approval.

2. The electrodes will be of MS rod of size as indicated in earthmat drawings enclosed in volume-III of the specifications.

3. The entire surface of the mat will be covered with good quality stone ballast passing 50 mm sieve and retained on 25 mm sieve, extended one meter beyond the periphery of the earthmat. The layer of the gravel is to be kept as 100 mm and shall be protected by providing suitable brick/stone lining at the outer most periphery to prevent it from spreading.

4. For size of the main earth strips and the risers, refer main earthmat drawing.

5. Fencing is not to be connected to earthing system but a continuous earthing strip should be laid at distance of 2 meter outside the fence. This continuous ring should be connected to fencing corners and at an interval of about 20 meters.

6. Duplicate connections shall be made separately to each equipment & it’s support structure as per rule No. 61 (2) Indian Electricity Rules-1965. The two connections should be done from two different sides of the mass enclosing the structure or equipment to be earthed. Each riser to the structures be bolted by two bolts to the structure leg.

7. Lightning arresters should be separately connected to nearest earthing electrode by shortest and straight connections.

8. Distance between the electrodes should not be less than four meters.

9. The main earthing strip at each crossing will be electrically welded unless specified otherwise.

10. The grounding mains in the switch house building for the auxiliaries are to be laid in cable trenches.

11. For rust protection of all joints, welds located in soil should be coated with molten bitumen and covered with bitumen impregnated tape.

12. Earthing strip near entrance and the approach road to the territory of the switch yard and to the switch house building is to be laid at a depth of 1.2 meters.

13. Separate earthing electrodes should be provided immediately adjacent to the structure supporting coupling capacitors and PTs. The earthing connections there should be as short and as free from changes in direction as possible. This earth should be used for high frequency equipment. The structure supporting coupling capacitors or PTs should be earthed in normal manner.

14. Before welding steel strip should be clamped tightly to ensure good surface contact between them. The contacting surface should be properly cleaned and all the connecting sides are to be properly welded.

15. Where dia. of bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar the connections to the bolt shall be made with wider piece or flag of metal jointed to the bar.

16. Overhead ground wire of the transmission lines should be solidly connected to the grounding grid.
17. For equipment earthing including bus isolators, the main members of steel structures supporting the equipment shall not be used to connect the earthing terminal of equipment to the riser coming from mat. In case of earthing switch also, the structures shall not be relied upon to provide earth connections from them to the system. Riser from ground mat should be directly connected to the earthing terminal of the earthing switches.

18. Any water pipes drainage pipes and power cable etc. should be kept isolated from any metallic part of the unclimable fencing and main earthmat.

19. The electrodes are to be driven as deep as feasible.

20. Watering to electrodes is not to be done.

21. In the region of crossing of ground mat with cable trench, rail track or foundation of transformer, control room foundation, the ground mat be laid 300mm below the foundation of compacted earth.

22. Where, there is a difference of level in switch yard, ground mat within 5 meters of it should be lowered to the depth of ground mat in lower terrace.

23. All reinforcements of the switch house will be earthed through 50x12mm ground bus, connected to earthmat riser at only one point.

24. All the welded joints, in the earthmat will be done as per the drawing provided by RSDCL.
1.0 SCOPE

This specification covers design & engineering of Sub-station lighting system using LED lamps and accessories, tubular poles (from main gate to the control room/switchyard gate and along boundary wall roads) distribution pillar boxes, PVC cables, conduit steel trays etc. which shall be supplied by the contractor for installation of luminaries, their control gear and wiring on them at an appropriate height above gravel level. The bidder will also design, supply and install lighting fixtures and accessories required for Control Room building and entry points/ Gates etc. The lights in switchyard shall be provided on different types of sub-station structures at selected points.

2.0 GENERAL TECHNICAL REQUIREMENTS

The lighting system for outdoor and indoor areas of sub-stations shall be designed in such a way that uniform illumination is achieved. In outdoor switchyard, only equipment/ bus bar areas are to be illuminated and luminaries shall be aimed as far as possible towards Transformers and circuit breakers. The wattage of LED Luminary is to be suitably decided after conducting the detail engineering for the locations, where these Luminaries are to be used. The Locations are generally in EHV grade Sub-station switch yard area, Street Lighting, Control Room Building etc. Latest practices of adoption of these systems are to be strictly followed. Details of design for adoption of LED Luminary system is to be furnished for review, its acceptance and approval. The Contractor shall submit general arrangement/ lighting layout and wiring diagram with all terminal details for approval of the RSDCL.

A. LIGHTING FIXTURE:

(a) All lighting fixtures complete with required LED lamps suitable to be fitted inside switch yard & all street light and LED lights for indoors (adopted as per Govt. norms for energy efficiency) and all required accessories shall be within the scope of the bidder.

(b) Fixture shall conform to latest IS/ IEC and its latest amendment. All equipments and accessories shall be suitable for continuous operation.

(c) LED lamp fixtures shall be complete with all necessary wiring and accessories. These shall be mounted in the fitting assembly only. Flood lighting shall have suitable base plate/ frame for mounting on switchyard structures.

(d) The emergency lighting fixtures shall be designed for use in 220 V ±10% DC system.

(e) Light fittings shall be so arranged that the required lux values specified are maintained, with supply of required fixtures and supports.

(f) Each lighting fixture shall be provided with a suitable earthing terminal.

(g) All fixtures shall be designed for minimum glare. The finish of the fixture shall be such that no bright spots are produced either by direct light source or by reflection.

(h) MCCBs, MCBs & Surge Protection Devices of reputed make complying with relevant IS & IEC shall be used.

(i) All receptacles shall be of cast steel or aluminium, heavy duty type, suitable for fixing on wall or column and complete with individual switch.

The different types of lighting fixtures to be provided shall be to the approval of the RSDCL.

B. LIGHTING POLES:

The lighting poles required for street lighting shall be hot dip galvanised steel tubular type complete with fixing brackets and junction boxes and shall conform to the drawings approved by the RSDCL.
C. LIGHTING WIRES & CABLES:

The wiring used for lighting shall be of 1100V grade, PVC insulated cable of standard products of reputed manufacturers. Armoured PVC cables are to be used for the switch yard lighting, street lighting and any other outdoor lighting system.

D. GROUNDING:

All lighting panels, junction boxes, fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. Rules.

3.0 LIGHTING LEVELS

3.01 The average LUX level of 20 is to be maintained in switchyard. However, a lux level of 50 is to be maintained in switchyard on main equipments such as transformer and circuit breakers.

3.02 Lighting in other areas such as control room, office rooms, PLCC room and battery room & other areas (i.e street light) shall be such that the average LUX level to be maintained shall be as under:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Area</th>
<th>LUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Room</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>Office/PLCC room</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>Battery &amp; other rooms</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Other areas</td>
<td>30</td>
</tr>
</tbody>
</table>

3.03 The lighting level shall take into account appropriate light output ratio of luminaires, coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition.

4.0 EMERGENCY LIGHTING

4.01 The Emergency Lighting shall operate automatically on failure of AC lighting supply. Separate wiring and distribution board shall be provided for these lights. Light points using LED lamps (DC) of 70W as per following requirement shall be provided by the contractor:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Room - 2 Nos.</td>
</tr>
<tr>
<td>2</td>
<td>Battery Room - 1 No.</td>
</tr>
<tr>
<td>3</td>
<td>PLCC Room - 1 No.</td>
</tr>
<tr>
<td>4</td>
<td>Office - 1 No.</td>
</tr>
<tr>
<td>5</td>
<td>Corridor - 1 No.</td>
</tr>
</tbody>
</table>
This specification covers design of Fire Fighting equipments for Pooling Sub-stations. Following type Fire Fighting equipments shall be supplied and erected by the contractor at each Pooling Sub-station. The Fire Fighting equipments to be supplied at Pooling Sub-station sites against this specification shall conform to the latest applicable standards.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars of equipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ISI Marked, trolley mounted Fire Extinguishers mechanical foam type 9 litre capacity with initial charge confirming to (IS:10204) with latest amendments.</td>
</tr>
<tr>
<td>2.</td>
<td>ISI Marked, trolley mounted dry powder (cartridge type) 6 kgs. with nozzle &amp; discharge fitting material of brass and having initial dry powder charge confirming to (IS:2171) with latest amendments.</td>
</tr>
<tr>
<td>3.</td>
<td>ISI Marked, trolley mounted dry powder (cartridge type) 9 kgs. with nozzle &amp; discharge fitting material of brass and having initial dry powder charge confirming to (IS:2171) with latest amendments.</td>
</tr>
<tr>
<td>4.</td>
<td>ISI Marked, trolley mounted CO2 type 9 kgs. capacity duly charged, complete in all respect with all accessories hose pipes, discharge horn, suitable for fire fightings in oil, petroleum products and gas substances under pressure and also for fires involving electrical equipments confirming to IS: 2878 with latest amendments.</td>
</tr>
<tr>
<td>5.</td>
<td>ISI Marked, trolley mounted CO2 type 4.5 kgs. capacity duly charged, complete in all respect with all accessories hose pipes, discharge horn, suitable for fire fightings in oil, petroleum products and gas substances under pressure and also for fires involving electrical equipments confirming to IS: 2878 with latest amendments.</td>
</tr>
<tr>
<td>6.</td>
<td>ISI Marked, Fire Buckets along with stands (Each stand suitable for 6 buckets). The stand shall be grouted properly at required place.</td>
</tr>
</tbody>
</table>
**TECHNICAL SPECIFICATION FOR FABRICATION, GALVANISING & TESTING OF SUB STATION STRUCTURES ALONGWITH REQUIRED G.I. BOLTS, NUTS (ISI MARKED), SPRING WASHERS ETC.**

1.0 **SCOPE:**

1.1 This specification covers design, fabrication, galvanization & testing of the structures as a complete package alongwith required GI bolts with nuts (ISI marked) & Electro-galvanized spring washers etc., complete in all respect as per the structural drawings to be provided by the purchaser to the successful bidder who in turn shall prepare model assemblies after developing shop drawings. After approval of model assembly, the final bill of material for the purpose of payment shall be prepared by the bidder and shall be submitted for approval to the purchaser. The unit weight of G.I. Bolts & Nuts and spring washers shown below are only indicative and the bidders are required to supply G.I. Bolts & nuts and electro galvanized spring washer based on actual BOM/approved model assembly. The weight of structure, GI Bolts & Nuts, Spring washers etc. shown below is TENTATIVE and the actual weight shall be as per approved BOM based on Proto/Model Assembly inspection.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Type of Structure</th>
<th>Unit Wt. of Structure alongwith Bolts &amp; Nuts, Step Bolts &amp; Nuts and Spring Washers (MT)</th>
<th>Weight of Structure in (MT)</th>
<th>Weight of GI Bolts &amp; Nuts (MT)</th>
<th>Weight of Spring Washers (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AT1</td>
<td>2.560979</td>
<td>2.47800</td>
<td>0.077705</td>
<td>0.005274</td>
</tr>
<tr>
<td>2</td>
<td>AT3</td>
<td>1.694150</td>
<td>1.642370</td>
<td>0.048280</td>
<td>0.003500</td>
</tr>
<tr>
<td>3</td>
<td>AT4</td>
<td>3.436822</td>
<td>3.305000</td>
<td>0.123758</td>
<td>0.008064</td>
</tr>
<tr>
<td>4</td>
<td>AT6</td>
<td>0.980670</td>
<td>0.945800</td>
<td>0.032460</td>
<td>0.002140</td>
</tr>
<tr>
<td>5</td>
<td>AT8</td>
<td>1.618004</td>
<td>1.570000</td>
<td>0.04881</td>
<td>0.003123</td>
</tr>
<tr>
<td>6</td>
<td>AB</td>
<td>1.544000</td>
<td>1.468000</td>
<td>0.071029</td>
<td>0.004971</td>
</tr>
<tr>
<td>7</td>
<td>BT1</td>
<td>1.790798</td>
<td>1.712000</td>
<td>0.073731</td>
<td>0.005067</td>
</tr>
<tr>
<td>8</td>
<td>BT3</td>
<td>1.324292</td>
<td>1.266230</td>
<td>0.051483</td>
<td>0.003879</td>
</tr>
<tr>
<td>9</td>
<td>BT4</td>
<td>2.594846</td>
<td>2.483590</td>
<td>0.104407</td>
<td>0.006849</td>
</tr>
<tr>
<td>10</td>
<td>BT6</td>
<td>0.700938</td>
<td>0.669000</td>
<td>0.029760</td>
<td>0.002178</td>
</tr>
<tr>
<td>11</td>
<td>BT7</td>
<td>1.186982</td>
<td>1.132000</td>
<td>0.051418</td>
<td>0.003564</td>
</tr>
<tr>
<td>12</td>
<td>BB1</td>
<td>0.810010</td>
<td>0.760000</td>
<td>0.046500</td>
<td>0.003510</td>
</tr>
<tr>
<td>13</td>
<td>AO1</td>
<td>1.097214</td>
<td>1.072400</td>
<td>0.023131</td>
<td>0.001683</td>
</tr>
<tr>
<td>14</td>
<td>AO1(T) (Single unit)</td>
<td>0.236476</td>
<td>0.22900</td>
<td>0.006963</td>
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</tr>
<tr>
<td>15</td>
<td>AO3</td>
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<td>0.255100</td>
<td>0.009568</td>
<td>0.000720</td>
</tr>
<tr>
<td>16</td>
<td>AO4</td>
<td>0.231212</td>
<td>0.221400</td>
<td>0.009128</td>
<td>0.000684</td>
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<tr>
<td>17</td>
<td>AO5</td>
<td>0.196600</td>
<td>0.183000</td>
<td>0.012700</td>
<td>0.000900</td>
</tr>
<tr>
<td>18</td>
<td>BO1</td>
<td>0.593172</td>
<td>0.572900</td>
<td>0.0118904</td>
<td>0.001368</td>
</tr>
<tr>
<td>19</td>
<td>BO1(T)</td>
<td>0.171392</td>
<td>0.164200</td>
<td>0.006697</td>
<td>0.000495</td>
</tr>
<tr>
<td>20</td>
<td>P</td>
<td>0.089500</td>
<td>0.081700</td>
<td>0.007296</td>
<td>0.000504</td>
</tr>
<tr>
<td>21</td>
<td>Q (W/o Stub)</td>
<td>0.632500</td>
<td>0.614500</td>
<td>0.016866</td>
<td>0.001134</td>
</tr>
<tr>
<td>22</td>
<td>Q (with Stub)</td>
<td>0.713328</td>
<td>0.688500</td>
<td>0.023226</td>
<td>0.001602</td>
</tr>
<tr>
<td>23</td>
<td>R</td>
<td>0.440964</td>
<td>0.428500</td>
<td>0.011672</td>
<td>0.000792</td>
</tr>
<tr>
<td>24</td>
<td>GD Beam</td>
<td>0.540270</td>
<td>0.513200</td>
<td>0.025170</td>
<td>0.001900</td>
</tr>
<tr>
<td>25</td>
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<td>0.044000</td>
<td>0.005859</td>
<td>0.000423</td>
</tr>
<tr>
<td>26</td>
<td>Y W/o Stub</td>
<td>0.332140</td>
<td>0.313000</td>
<td>0.017840</td>
<td>0.001300</td>
</tr>
<tr>
<td>27</td>
<td>Y with Stub</td>
<td>0.385220</td>
<td>0.365000</td>
<td>0.018850</td>
<td>0.001370</td>
</tr>
<tr>
<td>28</td>
<td>Z</td>
<td>0.298513</td>
<td>0.289000</td>
<td>0.008883</td>
<td>0.000630</td>
</tr>
<tr>
<td>29</td>
<td>GF 5.4 mtr.</td>
<td>0.250000</td>
<td>0.23000</td>
<td>0.018780</td>
<td>0.001220</td>
</tr>
<tr>
<td>30</td>
<td>33 KV CT &amp;</td>
<td>0.196030</td>
<td>0.19030</td>
<td>0.005330</td>
<td>0.000400</td>
</tr>
</tbody>
</table>
### 2.0 STANDARDS:

2.1 All materials shall comply in all respect with the requirements of the latest edition of the following relevant Indian Standard Specification except as modified by this specification. Where the relevant ISS is not available, the material/equipment should comply the latest BSS.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Indian Standards</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IS: 209</td>
<td>Specification for Zinc ingots</td>
</tr>
<tr>
<td>2.</td>
<td>IS: 802</td>
<td>Code of practice for use of structural steel in overhead transmission line towers</td>
</tr>
<tr>
<td></td>
<td>PART – I</td>
<td>Material, Loads and permissible stress</td>
</tr>
<tr>
<td></td>
<td>PART – II</td>
<td>Fabrication, Galvanising, Inspection and packing</td>
</tr>
<tr>
<td></td>
<td>PART – III</td>
<td>Testing</td>
</tr>
<tr>
<td>3.</td>
<td>IS: 808</td>
<td>Dimensions for Hot Rolled Steel Beam, Column Channel and Angle Sections</td>
</tr>
<tr>
<td>4.</td>
<td>IS: 1367</td>
<td>Technical supply conditions for threaded steel fasteners</td>
</tr>
<tr>
<td></td>
<td>PART – III</td>
<td>Mechanical properties of Fasteners made of carbon Steel and alloy Steel – Bolts, Screws and Studs</td>
</tr>
<tr>
<td></td>
<td>PART – 6</td>
<td>Mechanical properties &amp; test methods for nuts with specified Proof loads</td>
</tr>
<tr>
<td></td>
<td>PART – XIII</td>
<td>Hot dip galvanised coatings on threaded Fasteners</td>
</tr>
<tr>
<td>5.</td>
<td>IS: 1573</td>
<td>Electro-plated coating for Zinc on iron and steel</td>
</tr>
<tr>
<td>6.</td>
<td>IS: 1852</td>
<td>Specification for Rolling and Cutting Tolerances for Hot Rolled Steel products</td>
</tr>
<tr>
<td>7.</td>
<td>IS: 2016</td>
<td>Specification for Plain Washers</td>
</tr>
<tr>
<td>8.</td>
<td>IS: 2062</td>
<td>Steel for General Structural Purposes</td>
</tr>
<tr>
<td>9.</td>
<td>IS: 2629</td>
<td>Recommended practice for hot dip galvanising of Iron and Steel</td>
</tr>
<tr>
<td>10.</td>
<td>IS: 2633</td>
<td>Method of testing uniformity of Coating of Zinc coated articles</td>
</tr>
<tr>
<td>11.</td>
<td>IS: 3063</td>
<td>Fasteners: Single coil rectangular section Spring Lock Washers</td>
</tr>
<tr>
<td>12.</td>
<td>IS: 4072</td>
<td>Specification for Steel for Spring Washers</td>
</tr>
<tr>
<td>13.</td>
<td>IS: 4759</td>
<td>Hot-dip Zinc coating on structural steel and other allied products</td>
</tr>
<tr>
<td>14.</td>
<td>IS: 5369</td>
<td>General requirement for Plain Washer and Lock Washers</td>
</tr>
<tr>
<td>15.</td>
<td>IS: 6610</td>
<td>Specification for heavy Washers for Steel Structures</td>
</tr>
<tr>
<td>16.</td>
<td>IS: 6745</td>
<td>Methods of determination of mass of zinc coating on zinc coated iron and steel articles</td>
</tr>
<tr>
<td>17.</td>
<td>IS: 6821</td>
<td>Method for sampling non-threaded Fasteners</td>
</tr>
<tr>
<td>18.</td>
<td>IS: 12427</td>
<td>Fasteners–Threaded Steel Fasteners–Hexagon head Transmission Tower bolts</td>
</tr>
</tbody>
</table>

### 3.0 MATERIALS:

3.1 The structure members should be made/fabricated from steel sections conforming to IS:2062-1984 (latest amended edition).

3.2 Procurement of zinc and all the steel material required for the fabrication of structures and fasteners such as angles, plates, flats, channel rods etc. shall be arranged by the bidder at his cost. The rate quoted for supply of structures shall include the cost of steel, fasteners and zinc also. The procurement of steel section used in the fabrication shall be the responsibility of the bidder and the purchaser will not be responsible for any extra cost of any type due to replacement of designed section by higher section in case of non-availability of designed sections.
3.3 The bidder shall make his own arrangements for the procurement of steel sections before commencement of works and of sufficient quantity of electrolytic zinc of proper quality for galvanizing structure members & fasteners. The purchaser shall be at liberty to have the samples of steel and zinc used in structures & fasteners, test checked in any laboratory at his own cost and reject the particular supply if it is observed below standard. However, GI bolts and nuts should be of ISI mark.

3.4 All raw materials required for the fabrication and galvanisation etc., and for complete execution of work shall be stocked in adequate quantity by the bidder to ensure that the progress of the work is not jeopardized.

4.0 FASTENERS- BOLTS, NUTS & WASHERS:

GI Bolts & nuts, pack washers, square washers & spring washers shall be used for joining the columns & beam members & shall be arranged by the bidder more than 5% of the actual requirement.

4.1 All Bolts shall conform to IS: 12427 & nuts shall conform to IS: 1363 (Part–III). The GI Bolts & Nuts should be ISI marked and shall be supplied from the following approved vendors:

<table>
<thead>
<tr>
<th>No</th>
<th>Vendor Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M/s A. V. Forgings, Mohali.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>M/s Ravi Engineers, Amritsar.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>M/s GKW, Kolkata.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M/s Karamtara Fasteners, Mumbai.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>M/s Anand Bolts, Ludhiana.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>M/s Techman (India), Chandigarh</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>M/s N. L. Engineers Pvt. Ltd., Mohali.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>M/s Deepak Fasteners, Ludhiana.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>M/s Forex Fasteners, Ludhiana.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>M/s Garg Fasteners, Ludhiana.</td>
<td></td>
</tr>
</tbody>
</table>

G. I. Bolts & Nuts shall be galvanised and shall have hexagonal heads and nuts, the heads being forged out of solid steel rods and shall be truly concentric and square with the shank. The shank shall be perfectly straight.

4.2 Fully threaded bolts shall not be used. The length of the bolts should be such that the threaded portion shall not extend into the place of contact of the members.

4.3 All Bolts shall be threaded to take the full depth of the nut and threaded far enough to permit firm gripping of the members, but not any further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3mm and not more than 8mm when fully tightened. All nuts shall fit hand tight to the point where the shank of the bolt connects to the head.

4.4 Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be of electro-galvanized steel and of the positive lock type. Their thickness shall be 3.5 mm for 16 mm dia. bolts and 2.5 mm for 12 mm dia. bolts. They shall be supplied from the following approved vendors:

<table>
<thead>
<tr>
<th>No</th>
<th>Vendor Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M/s Springlock Industries, Vadodara.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>M/s Chempromech Engineers, Nagpur.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>M/s Forbes &amp; Gokak Ltd., Mumbai.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M/s Navin Metal Industries, Kolkata.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>M/s N. L. Engineers Pvt. Ltd., Mohali.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>M/s Royal Springlock industries, Ludhiana.</td>
<td></td>
</tr>
</tbody>
</table>
4.5 INSULATOR STRINGS AND EARTH WIRE CLAMP ATTACHMENTS:

For attachment of tension/suspension insulator strings a suitable swinging hanger on the structure (Beam) shall be provided so as to obtain requisite clearance under extreme swinging conditions and free swinging of the string. The hanger shall be designed to withstand load required as per design.

5.0 DETAILS OF STRUCTURES FOR FABRICATION:

The type of structures alongwith their unit weights are specified above.

6.0 WEIGHTS:

The weight of structure shall mean the weight of structures calculated by using standard sectional weights of all steel structural members of the sizes indicated in the fabrication drawings and/or subsequently revised drawings and bill of material without taking into consideration the reduction in weight due to drilling of bolt-holes, skew cuts, chamfering etc. or the increase in weight due to galvanization.

7.0 DRAWING AND MODEL ASSEMBLY:

The structural drawings of each structure shall be given to the successful Bidders. The successful bidders shall develop shop drawings of individual members based on these structural drawings & shall offer one set of model assembly for checking/approval before commencement of mass fabrication. Such model assembly shall form part of the supply.

After successful checking of model assembly of structure(s) the bidder shall furnish 03 (Three) sets of drawings and Bill of Materials to the purchaser for approval. Out of which 01 (One) set shall be returned after approval.

8.0 FABRICATION AND WORKMANSHIP:

The fabrication of structures shall be in accordance with the following:

(i) All parts of the structures shall be fabricated in accordance with the shop drawings to be developed by the successful tenderer as per the structural drawings to be provided by the purchaser and to be approved by the purchaser.

Such shop drawing, containing complete information necessary for fabrication of the component parts of the structures shall be prepared. These drawings shall clearly show the member sizes, length and marks, hole positions, gauge lines, bend lines, edge distances, amount of chipping, notching etc.

(ii) In the case of members to be bent, the shop drawings will indicate provision for the variation in length to be made.

(iii) Structures shall be of stub construction. Unless otherwise specified, welding at any point shall not be permitted.

(iv) The structures shall be accurately fabricated to bolt together easily on the side without any undue strain on the structure members or in the bolt, otherwise, the structure or part of it shall be rejected.

(v) No bolt holes shall be more than 1.5 mm bigger than the corresponding bolt diameter.

(vi) Workmanship and finish shall correspond to the best modern fabrication practice. All steel sections before any work is done on them shall be carefully leveled, straightened and made true to method which shall not injure the material so that when assembled the adjacent surfaces are in close contact throughout. No rough edges shall be permitted anywhere throughout the work.

(vii) Cutting may be effected by shearing cropping, flame cutting or sawing. The surfaces so cut out shall be clean, smooth, reasonably square and free from any distortion.

(viii) In general all fabrication work shall conform to provisions of IS: 802 (Part –I) – with latest amendment. However the details given in this specification shall prevail in the specified items.
9.0 DRILLING AND PUNCHING:

9.1 All steel sections, before any cutting work is started shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued up after being punched and drilled. No rough edges fresh from shear shall be left. All sheared and cut-ends shall be flaked off.

9.2 Holes for bolts shall be drilled or punched through jig but drilled holes shall be preferred. All holes in material over 12mm thick must be drilled in one operation through the plates and sections forming the joint. The holes near the bend line of a bent member, on both sides of band line, shall be punched/drilled after bending and relative position of these holes shall be maintained with the use of proper template/jigs and fixtures.

9.3 Punched holes must be square to the plates and the walls of the holes paralleled. The following tolerance in accuracy of punched holes is permissible:-

(i) Holes must be perfectly circular and no tolerance in this respect is permissible.
(ii) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8 mm i.e. the allowable taper in a punched hole should not exceed 0.8 mm on diameter.
(iii) Holes must be square with the plates or Angles and slant holes will not be permitted.

All burrs left by drill or punch shall be removed completely. The tenderer shall state clearly the extent of punching covered. When the structure members are in position, the holes shall be truly opposite to each other. Drifting or riming to enlarge defective holes shall not be permitted. Minimum edge distance from the centre of any bolt holes shall not be less than what has been indicated hereunder:

<table>
<thead>
<tr>
<th>Diameter of bolts</th>
<th>Minimum flange width of sections</th>
<th>Minimum rolled edge distance</th>
<th>Minimum sheared edge distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 mm</td>
<td>45 mm</td>
<td>20 mm</td>
<td>23 mm</td>
</tr>
</tbody>
</table>

10.0 ERECTION MARK:

Each individual structure member shall carry a code number conforming to the component number given to it in the fabrication drawings/bill of material. The code number of approved sizes shall be stamped with a metal die on the member before galvanizing and shall be legible after galvanization. The letters indicating the different types of structures shall precede the code number. The name of the manufacturers in suitable code shall also be stamped with metal die. These markings shall be with marking dies of 16mm size.

11.0 GALVANISING:

All members of the structures shall be galvanized. Galvanizing shall be done after all fabrication work is completed. Galvanizing of the members of the structure shall conform to IS-4759 with latest amendments.

12.0 PACKING:

The material shall be boxed or bundled for transport in the following manner:

(a) Angles shall be packed in bundles securely wrapped four times around at each end and every feet with No.9 SWG gauge wire with ends twisted tightly. Gross weight of any bundle shall not exceed approximately 450 Kg.
(b) Cleat angles, brackets, filler plates and similar loose pieces shall be nested and bolted together in multiples and securely wired together through holes, wrapped round at least four times with No. 9 SWG gauge wire and ends twisted tightly. Gross weight of each bundle shall not exceed approximately 70kg.
(c) The packing shall avoid losses/damages during transit.
(d) Accessories such as Bolts & Nuts, spring washers, U-Bolts with nuts and flat washers /pack washers shall be packed in double gunny bags duly tagged/labelled to show contents in them.

13.0 MARKING OF PACKING:

13.1 Each bundle or package shall have the following marking on it:

(a) The name and designation of the consignee.
(b) Ultimate destination.
(c) The relevant marks & number of members or reference number of small components like gusset plates, various attachments, etc. for each identification.

13.2 The marking shall be stenciled in indelible ink on the top members in the bundles of structures steel.

14.0 INSPECTION, TESTING & CHECKING:

13.3 The finished products before acceptance shall be subjected to inspection in respect of dimensional checkup and testing as per IS: 2062 (latest amended), if not supported by certificate from main producer (viz. SAIL/TISCO/RINL). The certificate for type test (chemical composition & mechanical properties test) shall be furnished to this office along with inspection call, otherwise testing shall be arranged at independent / NABL accredited /Govt. approved Laboratory or shall be witnessed by the Inspecting Officer. However the marking of prime producer shall be verified physically by Inspecting Officer. If the same are in order then Inspecting Officer shall issue clearance subject to other satisfactory tests.

15.0 SAMPLING:

For ascertaining the conformity of the lot to the requirement of this specification, the inspection shall be carried out on each lot separately. The number of pieces selected at random shall be to the extent as indicated below:

(a) Workmanship & dimension checking : 3% sample taken from each type of finished structure materials.
(b) Chemical test : One sample from every 50 MT or part thereof of each section.
(c) Tensile test : One sample from every 50 MT or part thereof of each section.
(d) Bend test : One sample from every 50 MT or part thereof of each section.
(e) Galvanization test : One sample from every 50 MT or part thereof of each section.
RAJASTHAN SOLAR PARK DEVELOPMENT COMPANY LTD

VOLUME-II

SECTION-III

TECHNICAL SPECIFICATION

for

ERECTION, TESTING & COMMISSIONING

OF EHV POOLING SUB-STATIONS

[TURNKEY PROJECT]
Technical Specification for Erection, Testing & Commissioning of EHV Pooling Stations

This section covers the general practice adopted by RSDCL in erection and commissioning of various structures/equipments for construction of EHV Sub Stations. This is for the purpose of general guidance. However, this will not absolve the contractor from their responsibility to follow practice laid down in various national/international standards and the erection and installation manual of manufacturer of various equipments towards successful erection testing & commissioning of Switchyard.

1.0 Principal Parameters

The disposition of various bay equipments is shown in layout drawings enclosed in Vol. III.

The bus bar material used in the 220/33 KV Sub-station shall be suitable for following bus bar parameters:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Bus Bar and Jumper Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>220KV Main bus-I &amp; II</td>
<td>Twin AL-59 conductor (Moose equivalent)</td>
</tr>
<tr>
<td>2</td>
<td>220KV Transfer bus</td>
<td>Single AL-59 conductor (Moose equivalent)</td>
</tr>
<tr>
<td>3</td>
<td>220KV equipment interconnection</td>
<td>Single/Twin AL-59 conductor (Moose equivalent)</td>
</tr>
<tr>
<td>4</td>
<td>220KV overhead bus &amp; droppers in all bays</td>
<td>Single/Twin AL-59 conductor (Moose equivalent)</td>
</tr>
<tr>
<td>5</td>
<td>33 KV Main bus</td>
<td>Twin Tarantulla</td>
</tr>
<tr>
<td>6</td>
<td>33 KV Auxiliary bus</td>
<td>Single Tarantulla</td>
</tr>
<tr>
<td>7</td>
<td>33 KV equipment interconnection</td>
<td>Twin/Single Tarantulla.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Single Panther for 33kV PT)</td>
</tr>
<tr>
<td>8</td>
<td>33 KV overhead bus and droppers in all bays</td>
<td>Twin/Single Tarantulla.</td>
</tr>
<tr>
<td>9</td>
<td>33 KV Equipment Interconnection, overhead bus and droppers: (i) Bus coupler, Sectionaliser &amp; Transformer bay</td>
<td>Twin / Single Tarantulla</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) Feeder bay, if any</td>
</tr>
</tbody>
</table>

Various erection and commissioning activities shall be carried out as detailed in enclosed Annexure-A to E.
ANNEXURE-A

WORK OF LAYING OF SUB-STATION EARTHING

(A) EARTHING

(I) The earthmat design as per site conditions, standard norms & regulations and also in accordance with the requirements given hereunder shall be furnished by the contractor and shall be got approved from RSDCL.

(II) Earthing and lightning protection system installation shall strictly be in accordance with the latest editions of Indian Electricity Rules, relevant Indian standards and Codes of practice and Regulations, except where specifically increased/ enhanced in these specifications.

(a) Code of practice for Earthing IS : 3043.
(b) Code of practice for the protection of Building and allied structures against lightning IS: 2309.
(c) Indian Electricity Rules 1956 with latest amendments.

(III) All equipments and structures are required to be earthed by two separate and distinct connections with earth as per Rule 61 of the Indian Electricity Rules, 1956.

The neutrals of all voltage levels of Transformers shall be earthed through independent earthing. All these earthing points should be interconnected with the sub station earth mat. Each earthing lead from the neutral of the power transformer shall be directly connected to two earth electrodes separately which, in turn, shall be connected to the earth mesh. The transformer tanks as well as associated accessories like separate cooler banks shall also be connected to the earthmat at two points.

Capacitor Voltage Transformers & Lightning Arresters shall be earthed through two independent risers directly connected to earth electrodes which should in turn be connected to the sub station earthmat. The distance between the electrodes should not be less than 4.0 meters.

All other equipments such as Circuit Breakers, CTs, Isolators, Post Insulators, etc. shall also be earthed at two points.

Bus Bar structures and equipment structures shall be earthed at two points.

Marshalling boxes, cubicles, C&R Panels and all other metallic enclosures, which are normally not carrying any current, shall also be earthed.

All the earthing connections to the earthmat shall be by 2 Nos. direct earthing risers free from kinks and of the shortest length. The two earthing connections/ risers should be connected to the different sides of the earthmat enclosing the structure/ equipment to be earthed.

For equipment earthing (including isolators), the earthing risers should be connected to the earthing terminal/ pad of equipment and brought down along the leg/ main member of structure and connected to the earth mat. The structure shall not be used as a part of the earthing.

(IV) Details of Earthing System

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Size &amp; Material</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Main Earthing Conductor to be buried in ground</td>
<td>28/35/40 mm dia MS Rod</td>
<td>Size to be taken as per earth mat design of Sub Station.</td>
</tr>
<tr>
<td>b)</td>
<td>Earthing Conductor above ground &amp; earthing leads (for equipments) i.e. Risers</td>
<td>50x8mm M.S. flat</td>
<td>Size to be taken as per earth mat design of Sub Station.</td>
</tr>
</tbody>
</table>
c) Earthing Conductor above ground & earthing leads (for columns & aux. Structures) i.e. Risers

<table>
<thead>
<tr>
<th>Size to be taken as per earth mat design of Sub Station.</th>
</tr>
</thead>
</table>

50x8mm M.S. flat

---

d) Earthing of indoor LT panels, D.C. Panel, control & relay panels and out door marshalling boxes, MOM boxes, junction boxes & lighting Panels etc.

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Size to be taken as per earth mat design of Sub Station.</td>
</tr>
</tbody>
</table>

50x8mm M.S. flat

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e) Rod Earth Electrode

<table>
<thead>
<tr>
<th>Size to be taken as per earth mat design of Sub Station.</th>
</tr>
</thead>
</table>

28/35/40 dia, 3250 mm long MS Rod

---

(V) EARTHING CONDUCTOR LAYOUT

a) Earthing conductors in outdoor areas shall be buried at least 600 mm below finished ground level unless stated otherwise.

b) Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid minimum 300 mm below them and shall be re-routed in case it fouls with equipment/structure foundations by forming ‘U-loops. The average spacing for East West rows and North South rows of earthmat shall however be kept as near as possible to the spacing indicated in earthmat design.

c) Tap-connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment structure as per “Earthing Details”.

d) Earthing conductors along their run on cable trench, ladder columns, beams, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc. galvanised iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

e) Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.

f) Earthing conductors crossing the road shall be laid 300 mm below road or at greater depth to suit the site conditions.

g) Earthing conductors embeded in the concrete shall have approximately 50 mm concrete cover.

h) Earthing conductors shall be clamped with the equipment support structure at 1000mm interval.

(VI) EQUIPMENT AND STRUCTURE EARTHING

a) Earthing pads shall be provided for the apparatus/equipment at accessible position. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with Purchaser.

b) Metallic conduits shall not be used as earth continuity conductor.

c) A separate earthing conductor shall be provided for earthing lighting fixtures, receptacles, switches, junction boxes, lighting conduits etc.

d) Railway tracks within switchyard area shall be earthed at a spacing of 30 m and also at both ends.
e) Independent Earthing conductor for earthing of fencing shall be buried at a depth of 0.6 meters and shall be provided 2000 mm outside the switchyard fence. All the gates and every alternate post of the fence shall be connected to this earthing conductor at the corners and at every 20 meters.

f) Flexible earthing connectors shall be provided for the moving parts such as earthing, switches and operating handles of isolators, etc.

g) All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of Indian Electricity Rules.

h) Earthing conductor shall be run from the peaks of structures to the main earth mesh. The earthing bonds of the earth wire tension hardware shall be connected at the top of this earthing riser with bolts and nuts.

(VII) JOINTING

a) Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, dust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anticorrosive paint/compound.

b) Joint connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type and shall be as per drawing approved by RSDCL. For rust protections, the welds should be coated with bitumen compound and covered with bitumen impregnated tape to prevent corrosion.

c) Steel to copper connections shall be first bolted and then brazed and shall be coated with bitumen tape to prevent moisture ingestion.

d) All joints in the steel earthing system, except those where earth mat may have to be separated from equipment, etc. for testing, shall be made by electric arc welding. Welded surfaces should be painted with bitumen compound and afterwards coated with bitumen tape to protect them from rusting and corrosion.

e) Joints in the earthing conductor between the switchgear units and such other points which may be required to be subsequently opened for testing should be bolted type. The bolted connections, after being checked and tested, shall be painted with anticorrosive paint/compound. These joints should be accessible and suitable for being frequently supervised.

f) All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.

g) Bending of earthing rod shall be done preferably by gas heating.

h) All arc welding with large dia conductors shall be done with low hydrogen content electrodes.

(VIII) POWER CABLE EARTHING

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switch gear ends. Sheath and armour of single core power cables shall be earthed at switch gear end only.

(B) EARTHING PROCEDURE

Clearance of material, its transportation and distribution at site, placing/drivering of earth electrodes, laying of earth mesh and connection of earthing risers from equipment, base of structures, and earth shield wire from the peak of the structures.
(I) GENERAL INSTRUCTIONS:

a) For reference, a drawing showing the details of the electrode as well as the different types of joints and the method of jointing may be provided by RSDCL. The work shall have to be done as detailed therein and as prescribed / finalized by the Incharge of the work.

b) Minimum joints shall be made in the laying of the earth mesh as well as in preparing and laying of the risers.

(II) EARTH ELECTRODES:

a) Cutting of M. S. Rod to approximate lengths of 3.25 meters or more and preparation of one end as spike, if required, for placing / driving into the ground.

b) Excavation of the ground as required for placing / driving the electrode.

c) Driving of above prepared electrode into the earth by hammering or placing it in the excavated pit, as applicable, such that the top of the electrode is 0.55 meter below the foundation top level.

d) Joint of MS Rod to MS Rod at earth electrode and at mesh crossings.

e) After welding apply bituminous compound to the hot joints & cover the joints with bitumen impregnated tape.

f) Backfilling and compaction of the excavation after the completion of the work of placing/ driving the electrode, its welding to the earth mesh and its inspection by the Site Incharge.

(III) LAYING OF EARTH MESH:

(a) Digging of trench along the specified alignment to a depth of 0.80 metres below the foundation top level.

(b) Laying of earth mesh of M. S. Rod in the excavated trench.

(c) Straight Joints of M. S. Rods in the Earth Mat:

   (i) Place the rods so that they overlap each other by 4 times their diameter, e.g., 100 mm in case of MS Rod of 25 mm diameter. Clamp/ hold these two lengths of M.S. Rods together and weld them on both sides.

   (ii) Thereafter, place two pieces of M. S. Flat of size to be used for earthing risers and length 4 times the diameter of the rods on both sides of this joint, and weld these pieces on the rods. JOINT OF M.S. ROD TO M.S. ROD IN EARTH MAT.

   (iii) After welding, apply bituminous compound to the hot joints, and cover the joints with bitumen impregnated tape.

(d) Joint of MS Rod and Earth Electrode:

   (i) Clamp/ hold together the M.S. Rod and the earth electrode. First weld these together at the crossing point.

   (ii) Fabricate two cleats in the shape of M. S. Angles from M. S. Flat of size to be used for earthing risers and of length equal to 10 times the diameter of the M. S. Rod. Weld these at the joint. JOINT OF M.S. ROD TO M.S. ROD AT EARTH ELECTRODE.

   (iii) After welding, apply bituminous compound to the hot joints, and cover the joints with bitumen impregnated tape.
(e) Cross Joints of M. S. Rods in the Earth Mat:

(i) Clamp/hold together the two M. S. Rods crossing each other. First weld these together at the crossing point.
(ii) Fabricate four cleats in the shape of M. S. Angles from M. S. Flat of size to be used for earthing risers and of length equal to 10 times the diameter of the M. S. Rod. Weld these at all the corners of the joint. JOINT OF M.S. ROD TO M.S. ROD AT EARTH ELECTRODE AND AT MESH CROSSINGS.
(iii) After welding, apply bituminous compound to the hot joints, and cover the joints with bitumen impregnated tape.

(f) After completion of the work and its inspection by the Site Incharge, the backfilling of the excavation and its compaction to original condition shall be done.

(IV) PREPARATION AND FITTING OF RISERS:

a) Digging of trench to a depth of 0.80 metre below the foundation top level from the equipment/structure foundation to the nearest rod of the earth mesh.

b) Cut MS Flat of the required length and form/bend it, by heating if required, to form a smooth and regular shape to match with the shape/form of the equipment/structures/foundation. The shape of the risers should be same/similar for the same type of equipment/structure.

c) Lay the prepared MS flat riser from the equipment/structure/peak of the structure to the rod of the earth mesh in the excavated trench and then connect it to the equipment or structures or structure peak. The fitting to the equipment/structure may be bolted type (earthing terminal/pad of the equipment) or welded type (structure). For bolted type fitting, drill necessary holes in the riser and fix it with bolts & nuts. For welded type fitting, weld a length equal to at least twice the width of the M. S. Flat.

d) In case joints are required to increase the length of the M. S. Flat risers, the two lengths of the MS Flat should overlap each other by twice the width of the M. S. Flat. After placing the M. S. flats one above the other as above, clamp/hold them together to provide good surface contact. Weld the two sides of the joint as well as the part between the flats on the top surface. JOINT OF MS FLAT TO MS FLAT.

e) Weld the MS Flat riser to the rod of the earth mat after fitting/welding it to the equipment/structure/structure peak. Place the MS Flat below the rod, clamp/hold them together, and weld on both sides of the rod. Then form a piece of MS Flat 50 × 6 mm into a stirrup and place on the joint of the rod and flat. Alternatively, cut two pieces of MS Angle 50 × 50 × 6 mm of length equal to the width of the MS Flat and place these on both sides of the joint of the rod and flat. Weld these to both the rod and the flat. JOINT OF MS FLAT TO MS ROD OF EARTHMAT.

f) After welding apply bituminous compound to hot joint and cover the joints with bitumen impregnated tape.

g) After completion of the work and its inspection by the Site Incharge, the backfilling of the excavation and its compaction to original condition shall be done.

h) The portion of the risers above ground level shall be painted with red oxide paint and green enamel paint.

(V) PROTECTION:

a) Lightning protection (DSLP) shall be provided in the switchyard by shield wires. There may be some modifications in final arrangement.
b) The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.

c) M.S. Flat shall be run as down conductor from the peak of towers/columns to the earth mesh to connect the shield wire to the earthing system of the sub-station.

d) Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.

e) Down conductors used for above lightning protection shall be cleated on the structures at 2000 mm interval.

f) Connection between earth shield wire and each down conductor shall be made through the earth bond of the earth wire tension clamp.

g) Lightning conductors shall not pass through or run inside G.I. conduits.

h) All metallic structures within a vicinity of 2000 mm in air and 5000 mm below ground shall be bound to the conductors of lightning protection system.
ANNEXURE-B

WORK OF LAYING OF CABLES

(I) CABLE TAGS AND MARKERS:

a) Each cable run shall be tagged with numbers that appear in the cable schedule. The numbering of cables on the tags shall be done as per cable schedule and got approved from the Engineer. Generally, cable size, identification of initial point and terminating end of equipment/panel, and a cable number are punched on cable tag/marking strip.

b) The tag shall be of 1.0 mm thick aluminum with the number punched on it and securely attached to the cable by not less than two turn of 20 SWG GI wire conforming to IS:280. Cable tags shall be of rectangular shape for power cables and control cables.

c) Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate.

d) Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable joints".

e) The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

f) Cable tag shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall/floor crossing & on each duct entry. Cable tags shall be provided inside the switchgear, motor control centers, control and relay panels etc., wherever required for cable identification.

(II) STORAGE AND HANDLING OF CABLE DRUMS

Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication the drums may be rolled in the same direction as it was rolled during winding of the cables.

(III) CABLE SUPPORTS AND CABLE TRAY; MOUNTING ARRANGEMENTS:

a) The contractor shall provide embedded steel inserts on concrete floors/walls to secure supports by welding to these inserts or available building steel structures, for the purpose of casting in the control room.

b) The supports shall be fabricated from standard structural steel members.

c) Insert plates will be provided at an interval of 750 mm wherever cables are to be supported without the use of cable trays, such as in trenches, while at all other places these will be at an interval of 2000 mm.

(IV) LAYING OF CABLES IN TRENCHES:

The cables are placed in the racks in cable trenches. Power and control cables shall be laid in separate tiers. The order of placing cables (other than those directly buried) in cable trenches shall be as follows:

(a) Bottom tiers: Power Cables/ Cables having A. C. supply.
(b) Middle tiers: Cables from CT/ CVT/ PT.
(c) Upper most tiers: Cables having DC supply.
The cables are securely fixed on the racks in the cable trenches. Particular care shall be taken when cables are laid in vertical & inclined cable trenches/ galleries/ vaults or supports.

Pulling out of cables from stationary drums shall not be permitted. Rollers may be used while pulling cables, if required.

(V) CABLE TERMINATION AND CONNECTIONS:

a) The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer’s instructions, drawing and / or as directed by the Purchaser.

b) The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

c) Supply of all consumable material shall be in the scope of contractor.

d) The equipment will be generally provided with undrilled gland plates for cables entry. The contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.

e) Control cable cores entering control panel/ switchgear/ MCCB/ MCC/ miscellaneous panels shall be neatly bunched, clamped & tied with nylon strap or PVC perforated strap to keep them in position.

f) The contractor shall tag/ ferrule control cable cores at all terminations, as instructed by the Purchaser. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.

g) Spare cores shall be similarly tagged with cable numbers and coiled up.

h) All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

i) Single compression type nickel plated (coating thickness not less than 10 microns) brass cable glands as per IS:12943 shall be provided by the contractor for all power and control cables to provide dust and weather proof terminations.

j) The cable glands shall be as per IS:12943. They shall comprise of heavy duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality.

k) If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the contractor, as directed by the purchaser.

l) Cable lugs shall be insulated tinned copper solder less crimping type conforming to relevant ISS. Supply of same shall be in the scope of the contractor.

m) Solder less crimping of terminals shall be done using appropriate crimping tool. The cable lugs shall suit the type of terminals and size of cable provided.

(VI) DIRECTLY BURIED CABLES:

a) The contractor shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, supply and
installation of route markers and joint markers. The bidder shall ascertain the soil conditions prevailing at site, if he feels, before submitting the bid.

b) The cable (power and control) between LT station, control room, shall be laid in the buried cable trenches. In addition to the above, for lighting purpose also, buried cable trench can be used in outdoor area, where cable trenches are not provided.

c) Cable route and joint markers and RCC warning covers shall be provided wherever required. The voltage grade of cables shall be engraved on the marker.

(VII) INSTALLATION OF CABLES:

(i) Cabling shall be on cable racks, in built-up trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits laid in concrete ducts, run bare and clamped on wall / ceiling / steel structures etc. as shown in the drawings in detailed Engineering stage. Where specific cable layouts are not shown on drawings, contractor shall route these as directed by the Purchaser. Cables in cable vault provided below control room shall be laid in cable trays.

(ii) The contractor shall fabricate and install mounting arrangements for the support and installation of all the cables on angles at 750 mm spacing in the trenches. These mounting structures / cable racks shall be fabricated from structural steel members (channels, angles and flats) of the required size. The fabrication, welding and erection of these structures shall conform to the relevant clauses of chapter - Structures, in addition to the specification given herein.

(iii) Cable racks and supports shall be painted after installation with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) followed by two finishing coats of aluminum paint. The red oxide and zinc chromate shall conform to IS:2074. All welding works inclusive of the consumables required for fabrication and installation shall be in the scope of the Contractor.

(iv) All cables from bay cable trench to equipment including all Interpole cables (both power and control) for all equipment, shall be laid in cable trenches of appropriate size. The scope shall include all labour, material, equipment for transporting, laying, burying etc.

(v) Cables shall be generally located in cable trench adjoining the electrical equipment. In all these cases necessary bending radius as recommended by the cable manufacturer shall be maintained.

(vi) Suitable arrangement should be used between fixed pipe / cable trays and equipment terminal boxes, where vibration is anticipated.

(vii) Single core cables in trefoil formation shall be laid with a distance of three times the diameter of cable between trefoil centre lines. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable.

(viii) Trefoil clamps for single core cables shall be of pressure die cast aluminum (LM-6), Nylon-6 or fiber glass and shall include necessary fixing GI nuts, bolts, washer etc. These are required at every 2 meter of cable runs.

(ix) Power and control cables shall be securely fixed to the trays. Vertical and inclined cable runs shall also be secured.

(x) Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows:

<table>
<thead>
<tr>
<th>Type of cable</th>
<th>Minimum bending radius</th>
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</thead>
<tbody>
<tr>
<td>Power cable</td>
<td>12 D</td>
</tr>
<tr>
<td>Control cable</td>
<td>10 D</td>
</tr>
</tbody>
</table>

(D is overall diameter of cable)
Where cables cross roads, drains and rail tracks, these shall be laid in cable trenches with reinforced walls and reinforced covers suitable for taking the load of the vehicles (including transformer) passing over them.

In each cable run some extra length shall be kept at a suitable point to enable (one for LT cables / two for HT cables) straight through joint(s) to be made in case the cable develop fault at a later date.

Selection of length of cables on cable drums shall be so planned as to avoid necessity of any straight through joints. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Purchaser. If straight through joints are unavoidable, the contractor shall use the straight through joints kit of reputed make as approved by the purchaser.

Control cable terminations inside equipment enclosures shall have sufficient lengths so that changing of termination in terminal blocks can be done without requiring any splicing.

Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required by the Purchaser.

Rollers may be used while pulling cables, if required.

All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kinks, sharp bends etc.

Cable ends shall be kept sealed to prevent damage.

Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard Codes of Practices.

Wherever cable pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cable, shall be supplied, installed and properly sealed by the Contractor at no extra charges.

Contractor shall remove the RCC/ steel trench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.

In case the outer sheath of a cable is damaged during handling/ installation, the contractor shall repair it at his own cost to the satisfaction of the purchaser. In case any other part of a cable is damaged, the total length of the cable shall be replaced by a healthy cable at no extra cost to the purchaser, i.e. the contractor shall not be paid for installation and removal of the damaged cable.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
WORK OF ERECTION OF EQUIPMENT STRUCTURES AND SUB-STATION STRUCTURES AND BEAMS

SCOPE OF WORK:

Clearance of material, its transportation & distribution at site and assembly, setting including fixing of template, levelling, grouting, erection, tightening & punching of nuts and bolts of equipment / sub – station structures / columns and beams complete in all respects.

(I) ERECTION TOOLS AND PLANTS:

The contractor shall arrange at his own expense all necessary erection tools & plants such as levelling instruments, tackles, spanners, jacks, winches, ropes, and any other T & P required for the erection of the structures / beams.

(II) SETTING, LEVELLING AND GROUTING:

(a) In case of structures with foundation bolts, the template, along with the foundation bolts tightened on it with nuts on both sides, shall be placed on the foundation and levelled & centered with reference to its location on the foundation. The length of the foundation bolts above the template shall be sufficient so that all parts of the base plate assembly of the structure and washer, nut and lock nut can be tightened fully and 2 – 3 threads are left above the lock nut. The template is leveled and centered with reference to its location on foundation. The foundation bolts shall thereafter be grouted ensuring that there is no displacement during the casting of the concrete and use of vibrator.

(b) In case of structures with stubs or structures with the lowest member being also used as a stub, the template or the assembled lower part of the structure with stubs shall be placed on the foundation and levelled & centered with reference to its location on the foundation. The stubs shall thereafter be grouted ensuring that there is no displacement during the casting of the concrete and use of vibrator.

While leveling and centering the structure / template, the following points should be checked:

(i) Level of structure/ template with reference to the finished foundation level or the ground level.
(ii) The level of the structure/template with reference to level of other similar structures.
(iii) Distance of centre line of the structure from the center line of other structures or from a reference point.
(iv) Centre to centre distance between structures, particularly structures which are to be connected together, for example, by a common beam.

(c) The difference in the elevation between the top of the foundation bolts or identical parts of any two stub angles / structure lower members shall not exceed 1 / 1000 of the horizontal distance between them.

(III) ERECTION OF STRUCTURES AND BEAMS:

(a) The method of erection shall be left to the Contractor subject to the condition that the method used does not damage RSDCL material and subject to observance of safety regulations.

(b) The work of erection of structures/ beams shall include erection of all the steel members, nuts & bolts, pack washers, spring washers, step bolts, U-bolts, & accessories, etc.

(c) The columns shall be truly vertical & the beams truly horizontal after erection. The columns shall not be out of vertical by more than 1 in 360 before stringing is carried out. The equipment structures shall also not be out of vertical by more than 1 in 360 before
erection of equipment is carried out. No straining of structure members shall be permitted to bring them to verticality / horizontality.

(d) Whenever asked to do so, the contractor shall get checked the verticality of the columns in the presence of RSDCL Engineer.

(e) The work of erection of beams on erected columns and erection of equipment on erected structures shall not be taken up until these have been inspected by the Engineer Incharge and cleared by him for taking up further erection activities.

(f) All bolted connections shall be well tightened using spring washers & then punched at three points on the circumference of the bolt.

(IV) DRAWINGS/ BILL OF MATERIAL:

The drawings and bills of material of the structures/columns/ beams shall be kept available by the contractor at site for inspection of RSDCL Engineer.
WORK OF STRINGING OF BUS BAR AND EARTHWIRE AND JUMPERING

SCOPE OF WORK:
The scope of work includes transportation of conductor, earthwire, disc insulators, suspension and tension hardware for conductor/earthwire and distribution at site, stringing of conductor bus bars & shield earthwire, fixing of earth bonds, jumpering at beams and peaks, jumpering between equipment, fixing of spacers, etc. as required at site.

GENERAL INSTRUCTIONS:

a) Care shall be taken during sagging operations so that no damage or deformation is caused to the structures.

b) The ends of the cut piece of conductor shall be tied with at least two rounds of binding wire so that the strand does not open out. The tying of the binding wire shall be done such that the binding wire does not get tightened in the groove of the T-Clamp or PG Clamp or the terminal connectors of the equipments.

c) Work at sending end substations may be required to be done where the adjacent or overhead or parallel portions may be energized. The Contractor shall therefore take adequate and sufficient safety measures to ensure that no electrical accident is caused during the execution of his work. The Contractor shall also arrange effective earthing for safety against induced voltages so that work can be carried out without any danger/hazard to his workmen.

d) Wherever it is necessary to avail shutdowns of energized circuits for carrying out the work, the Contractor shall submit a requisition to the Engineer Incharge stating the date and time and duration of the shutdown and the section/portion which is to be isolated. The shutdown shall be arranged by the Engineer Incharge and the Contractor shall ensure that the work is completed within the requisitioned time. The Contractor shall also carry out the effective earthing of the portion under shutdown.

(l) STRINGING OF CONDUCTOR BUS BARS:

a) The conductor shall be handled with utmost care to prevent scratches on it or damage to the strands of the conductor. The conductor shall be paid out after placing the conductor drum on a turntable or after jacking it up on a suitable size of shaft. During paying out, the conductor shall not be allowed to get damaged by touching or rubbing on the sides of the drum or on stones or any other metallic or hard object lying on the ground.

b) Disc insulators shall be cleaned and examined. Disc insulators having any hair cracks or chipping or defective glazing or any other defect shall not be used.

c) The disc insulators shall be assembled on the ground to form the suspension and tension strings as given below. After assembly of the strings, the mouth of the W – clips/ R – clips shall be widened to prevent any inadvertent removal during service.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>System Voltage</th>
<th>Suspension String</th>
<th>Tension String</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nos.</td>
<td>E &amp; M Strength (kN)</td>
</tr>
<tr>
<td>1.</td>
<td>220 kV</td>
<td>13</td>
<td>70</td>
</tr>
<tr>
<td>2.</td>
<td>33 kV</td>
<td>3</td>
<td>45/70</td>
</tr>
</tbody>
</table>

d) The suspension & tension hardwares shall be assembled as per their respective drawings alongwith the fitting of the relevant insulator string.

e) For stringing of bus bars, the conductor shall be fixed and tightened in the clamp of the tension hardware on one side of the bus. Thereafter, the complete hardware assembly with
the conductor shall be hoisted up and fixed on the beam at this end. Sagging arrangement shall be made on the other end of the bus and the conductor shall be tensioned.

f) Measurement of length of conductor required for the bus shall be made thereafter and the conductor shall be released so that it returns to the ground. The conductor shall be cut to the marked length after deducting the length of the tension hardware with insulators and fixed on the clamps of the tension hardware. The conductor along with tension hardware set shall then be again pulled up and connected to the beam.

g) Equalizing of tension in the different sub – conductors of the same phase and in the different phases shall be done, if required, to ensure equal sag of all the sub – conductors or between phases of the bus section as well as that of adjacent or parallel sections.

h) The spacers shall be fitted on the twin conductor bus bars. The spacers shall also be provided at points where jumpers are taken from the bus bar using T- clamps and/or P. G. clamps. Spacers are not used at jumper points in case T - Spacers are used for taking jumpers from multi conductor bus bars.

(II) STRINGING OF SHIELD EARTHWIRE:

a) The earthwire shall be handled with utmost care to prevent scratches on it or damage to the strands of the wire. The earthwire shall be paid out after placing the earthwire drum on a turntable or after jacking it up on a suitable size of shaft. During paying out, the earthwire shall not be allowed to get damaged by touching or rubbing on the sides of the drum or on stones or any other metallic or hard object lying on the ground.

b) The tension hardware shall be assembled as per its relevant drawing.

c) The shield / earth wire shall be fitted and tightened in the clamp of the tension hardware on one side. Thereafter, the complete hardware assembly along with the shield / earth wire shall be hoisted up and fixed on the peak of the structure at one end.

d) Sagging arrangement shall be made on the other end and the shield / earth wire shall be tensioned. Measurement of length of shield / earth wire required shall be made thereafter and the shield / earth wire shall again be released so that it is returned to the ground. The shield / earth wire shall be cut to the marked length after adding the length of the wire required for jumpering and fitted in the clamp of the tension hardware at the marked point. The shield / earth wire along with tension hardware set shall then be pulled up again and connected to the peak of the structure.

e) Adjustment of tension in the earthwire shall be done to ensure equal sag of all the earthwires in adjacent or parallel sections.

(III) JUMPERING OF CONDUCTOR AT BEAMS:

a) The suspension hardware shall be hoisted and fixed on the beams.

b) The appropriate length of the conductors shall be first cut and straightened so that kinks are removed.

c) The length of the conductor used and its natural curve should be such that a neat and proper curve is obtained in the jumper without any kinks or bends. The clamp of the suspension hardware shall be tightened after ensuring proportional lengths of the conductor on both the sides.

d) The jumpers from conductors shall be Y- type. The jumper shall be first connected to the conductor using a T- clamp suitable for the main conductor and the conductor being used for the jumpering. Thereafter, the main conductor shall be connected in parallel with the jumper conductor at the point of jumpering by using a piece of properly curved & shaped conductor and 2 Nos. PG - clamps, one on each side.
e) For jumpers from conductor to equipment, the conductor side jumper shall be connected as given above at at item (c) above. The other side of the jumper shall then be connected to the terminal connector of the equipment.

(IV) JUMPERING OF SHIELD EARTHWIRE:

a) The lengths of the earthwire which remain outside the tension hardware on the peak of the structures shall be cut if required so that these lengths when joined together form a smooth and proper curve. These shall be connected together using a PG - clamp.

b) The earth bond provided with the earthwire tension clamp shall be connected to the specified point on the peak of the structure and / or the M. S. Flat riser which is used as a down conductor from the peak for the purpose of connecting the shield earthwire to the earth mesh of the sub – station.

c) The tying of the binding wire on the ends of the earthwire shall be done such that the binding wire is not tightened in the groove of the PG - clamps.

(V) CONDUCTOR JUMPERING BETWEEN EQUIPMENT:

a) The appropriate length of the conductors shall be first cut and straightened so that curves and kinks are removed.

b) The jumper conductor shall then be connected to the terminal connectors of both the equipments and straightened or shaped as per site condition and as directed by the Site Incharge to give a neat and proper look.

c) Vertically supported insulators of equipments and post insulators should be checked for verticality again after jumpering on both sides.
1.0 EQUIPMENT ERECTION NOTES

1.1 Erection of equipment shall be carried out as per and in the manner prescribed in the erection, testing & commissioning manual/ instructions procedures of the manufacturer. For transformer & circuit breakers the services of the Manufacturer’s Engineer shall be utilized, any charges on this account shall be borne by the contractor.

1.2 All the equipment shall be perfectly levelled and vertical.

1.3 Adjustment/alignment of isolators including setting of limit switches, Aux. switches should be checked before and again after jumpering as both side.

1.4 Verticality of support insulators of equipments and bus P.Is should be checked again after jumpering on both side, and corrected if required.

1.5 All support insulators, circuit breaker interrupters and other fragile equipment shall preferably be handled with cranes having suitable booms and handling capacity.

1.6 The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.

1.7 Handling equipment, sling ropes etc. should be tested periodically before erection for strength.

1.8 Bending of compressed air piping if any should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced.

1.9 Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.

1.10 Mulmul or leather cloth shall be used for cleaning the inside and outside of hollow insulators.

1.11 All the equipment, instruments and auxiliaries required for testing and commissioning of equipment shall be arranged at site by the Contractor.

2. STORAGE

2.1 Contractor shall provide and construct adequate storage shed for proper storage of equipments, where sensitive equipments shall be stored indoors. All equipments during storage shall be protected against damage due to acts of nature or accidents. The storage instructions of the equipment manufacturer / purchaser shall be strictly adhered to.

(I) TRANSFORMERS:

a) All tools and plants whatsoever, such as oil filtration plant, oil storage tank(s), crane, etc. shall be arranged by the Contractor.

b) The work shall have to be carried out under the supervision of RVPN/ Manufacturer’s Engineer and as per instructions given by him/ them.

c) The erection work shall be got done generally as per instructions/ procedures given in the following documents:

   (i) Manufacturer’s Erection & Installation Manual
   (ii) Manufacturer’s Erection drawings.
   (iv) Transformer Manual (Technical Report No.1) issued by the Central Board of Irrigation & Power.

(A) Initial oil filling in Transformers received gas filled:

   (i) Oil Preparation:
       The oil supplied in oil drums (for first filling, topping up & OLTC) shall be first filled into oil storage tank(s) through filter machine. This oil shall then be filtered in the tank(s).

   (ii) The following oil values shall be attained so as to facilitate early and effective dehydration of transformer:
(a) Break Down Voltage: 70 kV (Minimum)
(b) Moisture Content: 10 ppm (Maximum)

(B) **Vacuuming of the Transformer:**

(i) Provide equalizing connections between main tank and OLTC Diverter Switch chamber(s) and isolate those parts of the Transformer which are not designed for vacuum.

(ii) Erection of the part of the pipeline between the tank and the conservator up to the Buchholz relay.

(iii) Connect breather to any valve above the tank oil level through a suitable pipe.

(iv) Connect a transparent plastic pipe (suitable for withstanding vacuum) between the top and bottom valves of the transformer to check the oil level.

(v) Apply vacuum to the transformer. The vacuum pipe is generally connected to the pipeline between transformer tank and conservator. The extent of vacuum and the time duration of its application shall be as per Manufacturer's recommendations.

(C) **Oil Filling:**

(i) The treated oil shall then be filled into the transformer tank under vacuum until the oil level reaches 250 mm below the top cover level. The oil level can be seen in the transparent plastic pipe provided.

(ii) The vacuum in the tank is then slowly released by slightly opening the valve on which the breather is connected so that only moisture free air goes inside the tank. The rate of release of vacuum should be kept very slow so that the silica gel in the breather does not get sucked into the tank.

(D) **This oil is filtered in the tank until the values given at A (ii) are attained.**

(E) **Transformers with separately mounted cooler banks:**

(i) Placing of cooler bank supports on foundation, leveling and centering of cooler bank supports (A – frame).

(ii) Erection of lower and upper headers on the A – frame.

(iii) Assembly and fitting of upper and lower cooler pipe line from transformer tank to respective headers including fixing of Valves, Pumps, Non Return Valves, expansion joints, oil flow indicators, etc., as per General Arrangement (GA) drawing. The arrow marks on the oil pumps and oil flow indicators should point towards the transformer tank.

(iv) Grouting of cooler bank supports (A – frame).

(v) Erection of Radiators on the headers.

(F) **Transformers with tank mounted cooler bank/ radiators:**

(i) Erection of headers, if provided.

(ii) Erection of radiators on headers / tank.

(G) **ERECTION OF ACCESSORIES:**

(i) Erection of main conservator & On Load Tap Changer (OLTC) conservator along with their supports.
(ii) Erection of HV & LV turrets, when supplied separately.

(iii) Erection of HV, LV & neutral bushing(s) and making their connections inside the tank, as required.

(iv) Fitting of Pressure Relief Devices along with pipes, if provided.

(v) Erection of Explosion Vent, if provided. Ensure that diaphragms are fitted on both ends of the vent pipe.

(vi) Assembly and fitting of equalizing pipeline between tank cover, turrets, inspection covers, etc. as provided.

(vii) Assembly and fitting of Buchholz pipeline, fitting of valves, expansion joints as provided and Buchholz relays, and connecting it to the equalizing pipeline and the main conservator. The arrow marks on the Buchholz relays should point towards the conservator.

(viii) Assembly and fitting of pipelines for breathers of main and OLTC conservators and fixing of breathers after checking the silica gel (to be replaced/ regenerated, if not of blue colour), and also filling of oil in the oil cup. Ensure that the sealing provided on the air passage of the breathers has been removed.

(ix) Assembly and fitting of pipeline for the OLTC Diverter Switch including valves and oil surge relay and connecting it to the OLTC conservator. The arrow marks on the oil surge relays should point towards the conservator.

(x) Assembly & fitting of cooler fans, including fitting of supports, if provided. The levelling, centering and grouting of ground mounted supports is to be got done before erection.

(xi) Erection/ placing of fan control cubicle/ marshalling box & OLTC drive mechanism. In case these are ground mounted, then these are to be placed on the foundation, levelled, centered and then grouted.

(xii) Filling of topping up oil in the transformer tank and conservator. During this process, the air release valves/ plugs provided on the top of the conservator should be kept open. The oil shall be filled up to 1/3rd level in the conservator.

(H) Dehydration of Transformer by Hot Oil Circulation until specified/ recommended values of insulation resistance and oil quality are attained.

(I) Pressurizing of air cell in the main conservator.

(J) Filling of oil in OLTC and its Dehydration.

(K) Release air from all air release points till there are no air bubbles in the oil coming out from these air release points.

(L) Assembly of OLTC Drive Mechanism & Operating System:

(i) Fix the brackets, gear boxes and operating shafts between OLTC drive mechanism and OLTC diverter switches. When connecting the operating shaft(s), ensure that the tap position indicated in the OLTC drive mechanism and at the head of OLTC diverter switch(es) are the same. Lock the bolts & nuts of the coupling brackets of the operating shaft(s), if provided.

(ii) Check the operation of the OLTC manually and make adjustments so that there are equal numbers of free turns of the operating handle after each tap change in the diverter switch both during Raise & Lower operations.
(iii) Synchronize the operation of all the three OLTC diverter switches so that all the three phases operate almost simultaneously.

**M** Cabling on the Transformer:

(i) Carry out laying of control cables from fans, protective relays, bushing/ WTI CT’s, etc. to the fan control cubicle/ marshalling box/ Temperature meter box.

(ii) Prepare the cables at both the ends and fit into cable glands.

(iii) Fix the cables on these cable gland plates and connect the wires as per schematic drawing.

**N** Fix/ fit minor the accessories.

**O** Specific checks/ tests prescribed by the manufacturer are to be carried out.

**P** PRE-COMMISSIONING CHECKS: It is to be ensured that:

(i) All equipments are mounted in position as per General Arrangement drawing of the manufacturer.

(ii) Minimum clearances between live parts and between live parts to earth are as per General Arrangement drawing.

(iii) Arrow on the Buchholz Relays & Oil Surge Relays is pointing towards the Conservator.

(iv) Arrow on the oil flow indicators and the oil pumps is pointing towards the transformer tank.

(v) Inspect the transformer all over and check all flanged joints and fittings for oil leakages. If found necessary, re-tighten the bolts.

(vi) Isolating valves in Buchholz pipe line and all the radiators and any valve if provided in the breather pipeline are fully opened and locked in the open position.

(vii) Oil level in the main conservator and OLTC conservator is as per the oil temperature.

(viii) Oil level in the condenser bushings.

(ix) The thermometer pockets provided for oil and winding temperature indicators are filled with oil.

(x) The colour of silica gel in the breathers is blue and that oil is filled up to correct oil level mark in the oil cup.

(xi) Buchholz relay contacts are not locked and these are in ‘SERVICE’ position.

(xii) The transport locks provided in equipment such as the MOLG, oil flow indicators, OTI, WTI, etc. have been removed.

(xiii) Setting of all the mercury switches for Alarm, Trip and Cooler control in the Oil and Winding Temperature Indicators.

(xiv) The Transformer neutral is connected to earth at two separate earth pits/ electrodes which in turn are connected to the earth mat.

(xv) The Transformer tank, OLTC drive mechanism, cooler bank, marshalling box, cooler control cabinet, temperature meter box, etc. as provided are earthed.

(xvi) Proper connections and tightness of terminal connectors provided on Bushings.
(xvii) Bolts & nuts of the coupling brackets of the operating shaft(s) of the OLTC have been locked.

(xviii) No oil is visible in Explosion Vent sight glass, if provided.

(xix) Setting of overload/ protection relays/ MCBs for fans & pumps and for OLTC motor as per their rating.

(Q) **PRE-COMMISSIONING TESTS:** Checking of:

(i) Operation of the corresponding auxiliary relays, Master Trip relays and alarm annunciation on actual operation of the transformer mounted protective Relays and supervisory equipments.

(ii) Tripping of HV circuit breaker & inter tripping of LV circuit breaker on operation of Master Trip Relays. This may be checked for operation of each Master Trip Relay for 2 or 3 protective relays.

(iii) Phase sequence of the AC supply to the Cooler Control Cubicle (CCC)/ Fan Control Cubicle (FCC)/ Marshalling Box.

(iv) Direction of rotation of fans and pumps.

(v) Operation of fans/oil pumps as per settings made in the winding temperature indicators.

(vi) Operation of stand by fans/ pumps on failure of each fan/ pump.

(vii) Lamp indications on RTCC Panel for fans and pumps.

(viii) Testing of alarm annunciations, such as “Fan Fail: Group-1 & 2”, “Cooler Control Supply Fail”, “Stand by Fan Fail: Group-1 & 2” etc. as provided in the RTCC Panel.

(ix) Manual operation of OLTC.

(x) Electrical operation of OLTC.

(xi) Reading of Oil & Winding temperatures on Remote Temperature indicators provided in RTCC Panel with reference to the OTI & WTI fitted on the transformer.

(xii) Testing of Transformer:

(a) Magnetizing current measurement of all three phases of LV winding with single phase supply.

(b) Magnetizing current measurement of all three phases of HV winding at Tap No. 1 with single phase supply.

(c) Magnetic balance test on all three phases of LV winding.

(d) Short circuit current measurement of all three phases of HV winding at Tap no. 1 with single phase supply applied between phase and neutral one by one with LV winding short – circuited and TV winding open – circuited.

(e) Short circuit current measurement of all three phases of HV winding at Tap No. 1 with single phase supply applied between phase & neutral one by one, LV winding is kept open-circuited.

(f) HV & LV WTI CT testing by measuring the current in the leads from the WTI CT terminals to the winding temperature indicator(s) during the above short circuit current measurement tests.
(g) Checking of continuity of contacts in diverter switch:

(h) Transformer Turns ratio measurement between HV & LV using turns ratio measuring instrument.

(i) Insulation resistance measurement (meggering) between HV-Earth, LV-Earth & HV-LV using 5 kV megger.

(j) Winding resistance measurement of all three phases of HV (at Tap No. 1) & LV windings.

(k) Measurement of Capacitance and Tan δ of condenser bushings and transformer windings.

(l) Checking of Vector Group of the transformer.

(m) Complete testing of Transformer oil (Test results shall be within limits as recommended in IS 1866:2000.)

The following tests are generally desired to be got carried out on transformer oil as per IS 1866:2000 -Code of Practice for Electrical Maintenance and Supervision of Mineral Insulating Oil in Equipment.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Property of Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Appearance</td>
</tr>
<tr>
<td>2.</td>
<td>Density at 29.5°C</td>
</tr>
<tr>
<td>3.</td>
<td>Neutralization value.</td>
</tr>
<tr>
<td>4.</td>
<td>Water Content</td>
</tr>
<tr>
<td>5.</td>
<td>Dielectric dissipation factor at 90°C and 40 Hz to 60 Hz.</td>
</tr>
<tr>
<td>6.</td>
<td>Resistivity (90°C)</td>
</tr>
<tr>
<td>7.</td>
<td>Breakdown Voltage</td>
</tr>
<tr>
<td>8.</td>
<td>Dissolved Gas Analysis</td>
</tr>
<tr>
<td>9.</td>
<td>Viscosity at 27°C</td>
</tr>
<tr>
<td>10.</td>
<td>Flash Point</td>
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<tr>
<td>11.</td>
<td>Pour point.</td>
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<tr>
<td>12.</td>
<td>Interfacial Tension</td>
</tr>
<tr>
<td>13.</td>
<td>Oxidation Stability of uninhibited oil</td>
</tr>
<tr>
<td></td>
<td>(i) Neutralization Value</td>
</tr>
<tr>
<td></td>
<td>(ii) Sludge</td>
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<tr>
<td>14.</td>
<td>Oxidation Stability of inhibited oil</td>
</tr>
<tr>
<td></td>
<td>(i) Induction Period</td>
</tr>
</tbody>
</table>

(n) Other tests as prescribed in IS 10028-1981:

(o) Other tests as prescribed in the Operation and Maintenance Manual of the Manufacturer.

(II) CONTROL & RELAY PANELS/ DC PANEL/RTCC PANEL/ LT PANEL:

ERECTION AND INSTALLATION:

(a) The panels shall be placed at their designated locations in the Control Room as approved by the Engineer In-charge.

(b) The panels shall be fixed / bolted on the trench provided in the floor of the Control Room or on the base frame as provided.
(c) In the case of Duplex type of panels, the control panel is to be connected to the relay panel across the corridor and bolted together. Corridor covers shall be fitted thereafter.

(d) The panels which form a Board or are to be placed adjacent to an existing Board shall be placed side by side and bolted together.

(e) The panels shall be levelled and arranged properly. There shall be no gaps between panels which are to be placed adjacent to each other.

(f) Bus wiring/ interconnecting wiring shall be done between the Duplex type control & relay panels and between control panel to control panel and/ or relay panel to relay panel which form a Board or are to be connected to an existing Board/Panel as per their relevant schematic drawings.

PRE-COMMISSIONING TESTS:

- Checking of tightening of all terminal connections.

- Checking of earthing of the panels to the earth mesh.

- Testing of individual relays, protection schemes, transducers, ICT's, indicating meters, integrating meters, etc. for conformity of their characteristics to the specifications and to the technical information/ details/ particulars intimated by the manufacturer.

- Testing and verification of individual relays, protection schemes, transducers, ICT's, indicating meters, integrating meters, etc. for their performance at the applied voltage/current/ operating supply and at the settings selected for their service conditions, and making necessary changes in the settings if and as required.

- Testing of protection scheme logics for alarm and trip as per approved schematic drawings.

- Testing of Carriers trip Commands.

- Testing of Annunciation scheme by actuating individual alarms from the initiating equipment such as relays, protection schemes, circuit breakers, transformer, etc.

- Testing of stability of protection schemes such as differential protection scheme for transformer, etc.

- Testing of tripping & inter-tripping of associated circuit breakers on the operation of relays/ protection schemes and their closing interlocks, etc. as provided in the scheme logic.

- Checking of operation of equipment from the control switches/ push buttons provided for them.

- Verification of indication lamps/ sema-phores by operating the relevant equipment.

- Testing of internal illumination system including operation of the door switches.

- Testing of functioning of space heaters and sockets, etc.

POST-COMMISSIONING CHECKS :

- Measurement of voltage & current in the relevant circuits, and checking their readings in the relays, protection schemes, meters, etc.

- Checking of phase sequence of the voltage in the control and relay panels.

- Checking of stability of transformer differential protection on load.

- Checking and verification of directional feature of over current, earth fault, and distance protection schemes, as applicable.
(III) **ISOLATORS:**

(a) Levelling of already erected structure(s) and minor fabrication work as required for erection of the Isolator & operating mechanism.

(b) Erection of the 3 Nos. base frames of individual phases on the already erected and leveled structure.

(c) Levelling and centering of the base frames.

(d) Fixing of link pipes on the rotating parts on the base frames of the individual phases.

(e) Assembly of the polycone insulator/insulator stack as applicable, fitting of male and female contacts (3 Nos. each) in case of single break Isolator or fixed contacts (6 Nos.) and moving contact (3 Nos.) in case of double break Isolator, and then erection of the above assemblies on the base frames.

(f) Adjustment/alignment of individual phases for smooth and complete opening and closing operation.

(g) Fixing of operating lever, male and female contacts and counterweights, etc. of the earth switches, where required, and their adjustment/alignment for smooth and complete opening and closing operation.

(h) Fitting of operating mechanism box for the Isolator and earth switch as applicable.

(i) Fitting of inter-phase operating pipes between the base frames of the individual phases.

(j) Fixing of main operating down pipes to operating mechanism for main Isolator and the earth switch, including fixing of operating levers.

(k) Final adjustment/alignment of main Isolator and earth switch for their smooth, synchronized and complete operation of all the three phases as a complete unit.

(l) Adjustment and setting of mechanical interlock between main Isolator and earth switch to ensure that earth switch does not close if main Isolator is closed, and that main Isolator does not close if earth switch is closed.

(m) Adjustment and setting of auxiliary switches and mechanical end stoppers for both the end positions of closing and opening operations. Adjustment of interlocking coil & plunger in closed and open positions.

(n) Fixing of arcing horns (make before & open after the main contacts), terminal connectors, earth bonds and other accessories, etc. as provided.

(o) Laying of cables and wiring.

**PRE-COMMISSIONING TESTS :**

- Measurement of insulation resistance with 5 KV megger between each phase to earth in the Isolator closed position.
- Checking of operation of Isolator and earth switch for smooth functioning, complete insertion and making of contacts in closed condition, functioning of mechanical interlock between main Isolator and earth switch, setting of end stoppers and operation of auxiliary switches.
- Checking of semaphore indications in C&R panel for Isolator and earth switch open and closed conditions.
- Checking of operation of inter locking coil in isolators and earth switches.
- Earthing of the main Isolator and the earth switch.

(IV) CIRCUIT BREAKERS:

(a) Erection of the support structure along with operating mechanism on the foundation, its levelling and centering and grouting, if applicable.

(b) Erection of the common base channel, or the base channel along with breaker poles, on the support structure, as applicable.

(c) Erection of the operating mechanism and control cubicle, as provided, on foundation & its levelling and grouting, or on the already erected and leveled support structure of the designated phase, or the three individual phases, or on the common structure, or on the common base channel, as applicable.

(d) Levelling of the top of the already erected support structure(s).

(e) Cleaning of breaker poles or breaker poles assembly as applicable.

(f) Erection of the breaker poles or breaker poles assembly on the support columns / support structure / common base channel as applicable.

(g) Placing of the air compressor, if provided separately, on its foundation, its centering and levelling, and grouting.

(h) Fabrication of compressed air pipeline, if applicable, and cleaning and fitting as per drawing. Pressurizing the compressed air pipeline and storage tanks, checking for leakage and attending to leakages detected. Checking of operation of pressure switches and safety valves and verification of their settings.

(i) Fitting of SF6 gas pipeline between poles, and filling of SF6 gas in the three poles to the prescribed pressure including checking of the operation of the alarm and lockout contacts provided in the density monitor during this filling. The SF6 gas shall be filled in one pole at a time to ensure that gas is being filled in all the three poles. Leakage of SF6 gas shall thereafter be checked and attended if detected.

(j) Laying of cables between operating mechanisms of individual phases and to control cubicle, or from common operating mechanism/ compressor to control cubicle, as applicable and as provided, fixing of cables in cable glands, fixing of cable glands on cable gland plates, and making connection of the cables as per schematic diagram of the circuit breaker.

(k) Dressing and fixing of cables in cable trays / trenches / supports / brackets.

(l) Fitting of terminal connectors on the three phases of the breaker.

(m) Operational checks of the circuit breaker as per erection and installation manual / instructions of the manufacturer.

PRE-COMMISSIONING TESTS:

- Measurement of insulation resistance with 5 KV megger in all the three phases between lower terminal to earth and between upper and lower terminals with the breaker in the open position.

- Checking of SF6 gas leakage.

- Checking of closing, opening and protection tripping operation of breaker from local and remote, operation of anti-pumping relay, pole discrepancy relay, if provided, annunciations of alarms, pressure switch settings, operation counter, resistance of closing and tripping coils, as applicable.
- Measurement of closing, opening and close – open operating timings of the breaker.
- Operation of the emergency tripping arrangement.
- Operation of auxiliary switch.
- Checking of space heater and internal illumination circuits.
- Earthing of the poles, control cubicle, operating mechanism, compressor & structure(s), as applicable.

(V) CURRENT TRANSFORMERS:

(a) Levelling of already erected structure(s) and minor fabrication work as required for erection of the current transformers.

(b) Measuring IR values of primary terminals to earth with 5 KV megger.

(c) Erection of the current transformers on the already erected and leveled structure(s).

(d) Fitting of terminal connectors on the current transformers.

(e) Laying of cables from secondary terminal box to the bay marshalling kiosks/ junction box, dressing and fixing of cables in cable trays/ trenches/ supports/ brackets.

(f) The cores of current transformers which are not used must be shorted and earthed in the Marshalling Kiosks/ Junction Box.

(g) Checking of the oil level in current transformer.

PRE-COMMISSIONING TESTS :

- Measurement of insulation resistance between primary winding to earth, primary winding to all the secondary windings and all secondary windings to earth.

- Checking of all the current ratios between the primary winding and all the secondary windings.

- Checking of polarity between the primary winding and all the secondary windings.

- Checking of knee point voltage of all the protection cores.

- Checking that the star/ neutral point of the secondary windings of the three phases of the current transformers has been made correctly and earthed in the junction box/ marshalling kiosk.

- Checking of the tightness of the connections of the wiring of the secondary windings in the secondary terminal box and in the junction box/ marshalling kiosk.

- Checking of the earthing of the current transformers & marshalling kiosks/ junction box.
- Checking of use of the secondary windings as per their accuracy class/ knee point voltage/ burden (protection/ metering), continuity of the current circuit of the secondary windings and the correct phases (R, Y, B) by applying current through primary injection in each current transformer and measuring the current in the respective equipment in the control room, such as meters and relays, etc., for each core at a time by shorting all the other cores in the current transformer.

(VI) CAPACITOR VOLTAGE TRANSFORMERS/ POTENTIAL TRANSFORMERS:

(a) Levelling of the already erected structure(s) and minor fabrication work as required for erection of the capacitive voltage transformers / potential transformers (CVT/ PT).
(b) Assembly of the different units of the same serial number of the CVT, if applicable.
(c) Erection of the CVT / PT on the already erected and leveled structure(s).
(d) Fitting of the covers on the joint between different units of the CVT, if applicable.
(e) Fitting of terminal connectors on the CVT’s / PT’s.
(f) Laying of cables from secondary terminal box to the bay marshalling kiosks/ junction box, dressing and fixing of cables in cable trays/ trenches/ supports/ breakers.

**PRE-COMMISSIONING TESTS:**

- Measurement of insulation resistance between primary winding to earth, primary winding to all the secondary windings, and all secondary windings to earth.
- Checking of all the voltage ratios between the primary winding and all the secondary windings.
- Checking of polarity between the primary winding and all the secondary windings.
- Checking that the formation of the star/ neutral point or open delta connections of the secondary windings of the three phases of the CVT’s/ PT’s has been made correctly and that the neutral/ one end of the open delta has been earthed in the junction box/ marshalling kiosk.
- Checking of the tightness of the connections of the wiring of the secondary windings in the secondary terminal box and in the junction box/ marshalling kiosk.
- Checking of the earthing of the CVT’s/ PT’s.
- Checking that there is no shorting in the wiring of the secondary circuit of the VTs.
- Checking of use of the secondary windings as per their accuracy class/ burden (protection/ metering), connections of the voltage circuit of the CVT/PT secondary windings and the correct phases (R, Y, B) by applying voltage through variac in each wire of the control cable from the CVT/ PT to the control room, and measuring the voltage at all points in the respective equipment in the control room, such as meters and relays, etc., for each core at a time while keeping all the other cores in the CVT/ PT disconnected.
- Earthing of HF Terminal of CVT if it is not used for PLCC system.

(VII) **LIGHTENING ARRESTERs:**

(a) Levelling of the already erected structure(s) and minor fabrication work thereon, or making mounting arrangements on the beams of the already erected sub-station structures, for erection of the Lightening Arresters and Surge Counters, as applicable & as required.
(b) Assembly of the different units of the same serial number of the Lightening Arresters, as applicable.
(c) Erection of the Lightening Arresters on the already erected and leveled structure(s), or on the already prepared arrangement on the beams of the sub-station structures.
(d) Fitting of the Surge Counter on the structure and making connection to the lowest unit of the Lightening Arrester above the base insulator, as applicable.
(e) Fitting of corona/ grading ring on the Lightening Arrester, as applicable.
(f) Fitting of terminal connectors on the Lightening Arresters.

**PRE-COMMISSIONING TESTS:**
- Measurement of insulation resistance between line end to earth, and of individual units of the Lightning Arrester, as applicable.

- Checking of clearance from earth of the connection between the Lightning Arrester and the Surge Counter.

- Checking of the tightness of the connection between the Lightning Arrester and the Surge Counter and from the Lightning Arrester/ Surge Counter to earth, as applicable.

- Checking of healthiness of the Surge Counter using a Surge Counter Testing Instrument.

**(VIII) WAVE TRAPS:**

(a) Fitting of Tuning Pot and associated equipment in the Wave Trap.
(b) Fitting of end covers on the Wave Trap properly and their tightening.
(c) Fitting of terminal connectors on the Wave Traps and checking their tightness.
(d) Mounting arrangement for pedestal type Wave Trap on suitable structure.

**(IX) LINE MATCHING UNIT (LMU)/LINE MATCHING DISTRIBUTION UNIT (LMDU):**

(a) Fitting of the LMU/ LMDU on the already erected structure.
(b) Earthing the LMU/ LMDU by connecting the earthing terminal to the earth mat.
(c) Connecting the HF terminal of the Capacitor Voltage Transformer to the HF terminal of the LMU/ LMDU.
(d) Laying the co-axial cable between LMU and LMDU.
(e) Preparing the ends of the co-axial cable and fixing the connectors at the ends.
(f) Fitting the co-axial cable on the LMU and LMDU.

**PRE-COMMISSIONING CHECKS:**

(i) Checking the tightness of the connection of HF terminal of the CVT & the connections in the LMU / LMDU.
(ii) Checking for any dry solder in the circuits of the LMU/ LMDU.
(iii) Checking the tightness of connections in the LMU/ LMDU.
(iv) Checking that the strappings inside the LMU/ LMDU are connected in the required manner so as to match with the impedance of the co-axial cable (75 ohms/125 ohms as the case may be).
(v) Checking of earthing of the LMU/ LMDU.

**(X) PLCC CARRIER SETS:**

(i) Placing the structure/ frame near the cable trenches in the PLCC room in such a manner that sufficient space is available for accessing the Carrier sets from the rear for maintenance as well as from the front for setting up test instruments.
(ii) Grouting of the structure/ frame.
(iii) Erection of the carrier sets at their locations on the fabricated structures/ frames, minimum spacing of 30mm be kept between two carrier sets on both the sides for proper ventilation.
(iv) Leveling of the carrier sets and fixing them on the structure/ frame.
(v) Insert the modules, if received separately, in their designated locations in the carrier Terminal.
(vi) Laying of the co-axial cable from LMDU to the Carrier set.
(vii) Preparing the ends of the co-axial cable and fixing the connectors at the ends.
(viii) Fitting of the co-axial cable on the carrier set and LMDU.
(ix) Checking of Earthing of the carrier set and the structure/frame.

**PRE-COMMISSIONING CHECKS.**

(i) Measuring the resistance of the earthing connections of the Carrier Sets to the earth mat.
(ii) Ensure that the earthing of the HF terminal of the CVT and the LMU/LMDU have been opened.
(iii) Visually checking the cards for any dry solder in the circuit.
(iv) Checking that all the modules are fitted in their correct locations.
(v) Checking the tightness of all terminal connections.
(vi) Checking that all the inter-connectors are fitted and properly inserted.
(vii) Checking that all strappings and settings of the DIP switches in the modules and on the rear side of the PCBs are in accordance with the programming table.
(viii) Checking the internal illumination system.
(ix) Checking the functioning of power sockets, etc.
(x) Ensure that the exhaust fan is working.

PRE-COMMISSIONING TESTS.

(i) Connect 48V from DC power source to Carrier set and check the polarity of DC voltage at the terminals.
(ii) Switch on the MCB.
(iii) Switch on the Power Supply Unit, Measure output voltage at the test points.
(iv) Carry out setting, measurement and adjustment of frequency and levels at both ends (transmitted / received) as per commissioning manual of the manufacture.
(v) Verification of:
   (a) Signaling operation by extending ground.
   (b) All the alarms in all the units.
   (c) Loop back status (local loop and remote loop).
   (d) Communication with the remote end operator over service telephone.
   (e) Any other setting/test as prescribed by the manufacturer.
(vi) Carrying out the following tests on the complete system:
   (a) Composite loss and return loss on coupling devices using dummy load.
   (b) Composite loss (attenuation) for HF cable coupling device.
   (c) End to end return loss of the adopted coupling mode (phase to phase $R&B$, or interphase $Y&Y$):
      (1) Open behind the wave trap.
      (2) Grounded behind the wave trap.
(vii) If the end to end return loss for the adopted coupling mode is not satisfactory, the same shall be measured for other coupling modes (phase to Phase $R&Y$ and $Y&B$, or interphase $R&R$ and $B&B$) to determine the optimum coupling mode. The wave traps and the connections to the CVTs should be got changed as per the optimum coupling mode.

(XI) CARRIER PROTECTION COUPLERS:

Fit the Protection Coupler in PLCC terminal, if received separately.

PRE-COMMISSIONING CHECKS:

(i) Visual check for any dry solder in the circuit boards.
(ii) Checking that all the modules are fitted in their correct locations.
(iii) Checking of tightness of all terminal connections.
(iv) Checking that all the inter-connectors are fitted and properly inserted.

PRE-COMMISSIONING TESTS:

(i) Checking the DC voltage and its polarity in the protection coupler.
(ii) Configuring the equipment as per programming table.
(iii) Checking $Tx$ and $Rx$ trip commands for their proper operation.
(iv) Testing the equipment on local loop test.
(v) Making connections from the respective relay panels to the MDF (main distribution frame) of the equipment as per scheme.

(vi) Putting the equipment on local loop test. Giving the trip command from Relay Panels and verify that the trip command is received back in the Relay Panels. This should be done for all the codes.

(vii) Putting the equipment in the normal mode at both ends. Verification of the transmission and receipt of Tx and Rx commands on all the codes of the Protection Coupler by initiating trip commands from the Relay Panels at both ends.

(viii) Checking of Annunciations by actuating individual alarms such as Carrier Fail, Carrier Received, etc. from the Protection Coupler.

(XII) BATTERY SET:

Battery charging and discharging and all activities related to the erection and installation of the Battery set are to be carried out as per the recommendations/ directions/ procedure given in the Erection & Installation Manual of the Battery Manufacturer.

(a) Assembly and installation of the mounting frame / stand in the battery room.

(b) Erection of modules containing the cell on the mounting frame/ stand as per Manufacturer’s manual and drawing.

(c) Making intercell connections as per manufacturers general arrangement drawing and tightening of inter-cell connectors to a torque as mentioned in the manufacturers erection manual.

(d) Laying of cables for connecting the battery set to the battery charger.

(e) Connecting battery set to battery charger.

(f) Giving a freshening charge to the battery set.

(g) The duration of freshening charge and the voltage at which the battery set is to be charged with reference to the ambient temperature, shall be as per manufacturers manual.

(h) DISCHARGE/ CAPACITY TEST:

(i) The Battery Set shall be discharged after keeping it open circuit for not less than 2 hours and not more 24 hours from the completion of full charge.

(ii) Discharging the Battery Set at its 10 hour rate, i.e., at a current equal to 10 % of its rated ampere hour capacity till the voltage of any one cell reaches 1.75 volts or the total battery close circuit voltage reaches $1.75 \times n$ (where n is the number of cells in the Battery Set), whichever is earlier.

(a) Maintaining the discharge current within ± 1 percent of the specified rate of discharge.

(b) Recording the voltmeter and ammeter readings every 5 minutes for the first 15 minutes, and thereafter every 15 minutes up to the end voltage.

(c) Noting the time in hours elapsing between the beginning and end of the discharge. This shall be taken as the period of discharge.

(d) The average temperature of the electrolyte during discharge shall be the average of the temperature readings noted at hourly intervals during discharge. The temperature of the battery terminal shall be measured as it will be almost the same as the electrolyte.

(iii) During the above discharge test, the cell voltages shall not be less than the following values:

(a) After six minutes from the start of discharge: 1.98 Volts.
(b) After six hours of discharge: 1.92 Volts.
(c) At ten hours of discharge: 1.75 Volts.

(iv) The capacity of the Battery Set is obtained by multiplying the discharge current in amperes by the time in hours as observed above. This capacity is corrected to 27 Deg. C by the formula:

$$C_{27} = C_t + C_1 \times 0.43 \times (27 - t),$$

----------
Where:
‘t’ is the average ambient temperature of the battery room,
‘C27’ is the Capacity of the Battery Set at 27 Deg. C, and
‘Ct’ is the measured Capacity of the Battery Set at ‘t’ Deg. C.

(v) If 100% or more capacity is achieved at any time during the above discharge test, equalize the voltage of all the cells as mentioned below. Finally charge the Battery Set as per para I and put it in operation in the floating mode.

(vi) The minimum acceptable capacity of the Battery Set (corrected to 27°C) which is to be achieved during the above discharge test is 85% of the rated capacity.

(vii) If 85% or more capacity is achieved during the above discharge test, then equalize the voltage of all the cells as given below:

(a) Bypass the cell that has first reached 1.75 V.
(b) Continue discharging the Battery Set at its 10 hour rate.
(c) Keep bypassing the cells that reach 1.75 V until the voltage of all the cells reaches 1.75V.

(viii) Charge and discharge the Battery Set until 100% capacity is achieved. If 100% capacity is achieved within another four discharges, finally charge the Battery Set and put it in operation in the floating mode.

(ix) The 100% capacity of the Battery Set shall be achieved within these 5 discharges.

CHARGING / RECHARGING:

(i) Immediately after the discharging is completed, the Battery Set should be charged by gradually increasing the voltage. The current should not be allowed to exceed 20% of the 10 hour capacity of the Battery Set or the capacity of the battery charger. The voltage should not be allowed to exceed 2.30 volts / cell.

(ii) Continue the charging till the charging current reduces to a negligible value.

(iii) After the Battery Set has been fully charged, switch off the boost charger. Switch on the float charger after setting its output voltage as per manufacturer’s recommendations.

(B) BATTERY CHARGERS

(i) Placing of the battery charger at its designated location in the control room as per layout.

(ii) Fixing / bolting of the battery charger on the trench provided in the floor of the control room.

PRE-COMMISSIONING CHECKS:

(i) Checking of tightening of all terminal connections.

(ii) Checking of the earthing of the battery charger to the earth mat.

PRE-COMMISSIONING TESTS:

(i) Connect only the AC supply cable from the LT Panel. The cables to the Battery Set and the DC panel should not be connected.

(ii) Switch on the AC supply and check the voltages on the terminals of the incoming cable.

(iii) Keep the Auto- Manual switch in Manual position. Switch on the Float charger. Raise the voltage manually to the required output value and check the voltage and polarity on the load and battery terminals. Lower the voltage manually to check operation of the control circuit.

(iv) Calibrate the DC voltmeter.

(v) Keep the Auto Manual switch in Auto position. Set the output voltage to the required value.

(vi) Put the switch in the manual position and lower the voltage. Put the switch in Auto position. The output voltage should increase to the set value. Repeat the above test by increasing the voltage. The output voltage should decrease to the set value. Adjust the voltage setting if required.
(vii) Check the annunciations such as AC supply fail", “DC earth fault”, “Fuse failure”, etc. as provided.
(viii) Switch off the Float Charger.
(ix) Keep the Boost Charger voltage selecting taps (Coarse and Fine)/ voltage setting at the minimum position. Switch on the Boost charger.
(x) Check the voltage and polarity on the battery terminals. Raise the voltage to the maximum output value and check the voltage on the battery terminals.
(xi) Set the voltage to the rated value. Put the keyed push button (Boost as Float) in the ON position, Check that the rated voltage is available on the load terminals.
(xii) Switch off the Boost charger.
(xiii) Connect the cables to the Battery set and the DC panel.
VOLUME -III

RAJASTHAN SOLAR PARK DEVELOPMENT COMPANY LIMITED

TURNKEY PROJECT

SPECIFICATION NO.

RSDCL/ D (T)/SP/ NOKH/PPS/TK/TN 03(2019-20)

OF

CIVIL WORKS

FOR CONSTRUCTION OF

4 NOS. 220kV PARK POOLING SUB STATIONS AT NOKH SOLAR PARK
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SECTION: CIVIL

1.0 GENERAL

The intent of specification covers the following:

Design, engineering, supply of material and construction of all civil works at sub-stations. All civil works shall also satisfy the general technical requirements specified in other sections of this specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this specification or implied as per National/International Standards.

All civil works shall be carried out as per applicable Indian Laws, Standards and Codes. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

The Bidder shall furnish all design, drawings, (Unless otherwise specified) labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Owner.

The work shall be carried out according to the design/drawings to be developed by the Bidder and approved by the Owner based on Tender Drawings supplied to the Bidder by the Owner. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Bidder keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Owner. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Bidder shall quote according to the complete requirements.

2.0 GEO-TECHNICAL INVESTIGATION

2.1 The Bidder shall perform a detailed soil investigation and Contouring to arrive at sufficiently accurate, general as well as specific information about the soil profile, levels and the necessary soil parameters of the Site in order that the foundation of the various structures can be designed and constructed safely and rationally.

A report to the effect will be submitted by the Bidder for Owner's specific approval giving details regarding data proposed to be utilized for civil structures design.

2.2 The Bidder may visit the site to ascertain the soil parameters. Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & condition of the Contract. Tests must be conducted under all the critical locations i.e. Control Room Building, Lightning Mast. Tower locations, transformer, dormitory etc.

2.3 SCOPE OF WORK

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out field investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Bidder shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the bench mark indicated by the Owner. All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

2.3.1 BORE HOLES

Drilling of bore holes of 150 mm dia in accordance with the provisions of IS: 1892 at the rate of minimum two number of bore holes per bay to 6 m depth or to refusal whichever occur
earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). In cases where rock is encountered, coring in one bore hole per bay shall be carried out to 3 m in bed rock and continuous core recovery is achieved.

Performing Standard Penetration Tests at approximately 1.5 m interval in the bore hole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100 / 75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

The depth of Water Table shall be recorded in each bore hole.

All samples, both disturbed and undisturbed, shall be identified properly with the bore hole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Bidder's laboratory without any damage or loss.

The logging of the boreholes shall be complied immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-charge.

2.3.2 DYNAMIC CONE PENETRATION TEST

Dynamic cone penetration tests of two numbers shall be carried out with the circulation of bentonic slurry at specified locations and a continuous record of penetration resistance (NG) up to 15.00 meter from natural ground level or the refusal shall be maintained by the Bidder IS: 4968 (Part-2) shall be followed for carrying out the test and reporting results.

The location for tests shall be as directed by the Owner. On completion of the test, the results shall be presented as a continuous record as the numbers of blows required for every 300 mm penetration of the cone into the soil.

2.3.3 TRIAL PITS

Trial pits shall be carried at specified one locations of per bay as directed by the Owner. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Owner. Undisturbed samples shall be taken from the trial pits as per the direction of the Owner.

2.3.4 ELECTRICAL RESISTIVITY TEST

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.5 m up to a distance of 10.0 m.

2.3.5 WATER

The Bidder shall make the arrangement of water for constructional activities at his own cost. The sample of water shall be got tested for its chemical analysis and it should be suitable for construction of civil works as per norms of relevant IS codes/ specifications.

2.3.6 BACK FILLING OF BORE HOLES

On completion of each hole, the Bidder shall backfill all bore holes as directed by the Owner. The
Back fill material can be the excavated material.

2.3.7 **LABORATORY TEST**

2.3.7.1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples have reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2.3.7.2. All samples brought from field, whether disturbed or undisturbed shall be extracted/ prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant I.S. codes.

The following laboratory tests shall be carried out:

(a) Visual and Engineering Classification.
(b) Liquid limit, plastic limit and shrinkage limit for C-0 soils.
(c) Natural moisture content, bulk density and specific gravity.
(d) Grain size distribution.
(e) Swell pressure and free swell index determination.
(f) California bearing ratio.
(g) Consolidated drained test with pore pressure measurement.
(h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value & organic matter and any other chemical harmful to the concrete foundation.
(i) Rock quality designation (RQD), RMR in case of rock is encountered.

2.3.8 **THE RESULTS AND REPORTS**

2.3.8.1 The Bidder shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Bidder in draft form and after the draft report is approved, the final report in four (4) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of RSDCL.

2.3.8.2 The report shall include, but not limited to the following:

(a) A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests, trial pits, Plate load test etc.

(b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, shall be enclosed.

**Recommendations:** The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Bidder shall acquaint himself about the type of structures and their functions from the Owner. The observations and recommendations shall include but not limited to the following:

(a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.
(b) Recommended type of foundations for various structures.
(c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil shall be provided.

(d) Recommendations regarding slop of excavation and dewatering schemes, if required.

(e) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

(f) If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

(g) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

3.0 SITE PREPARATION:

**Site will be handed over in “AS IS WHERE IS” condition.** The layout and levels of all structure etc shall be made by the successful Bidder at his own cost from the general grids of the plot and benchmarks set by the Bidder and approved by the Owner. The Bidder shall give all help in instruments, materials and personnel to the Owner for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

Site shall be graded to the levels as per the FGL (finished grade level) which includes clearing the site area free of bushes, trees including removal of roots, any unsuitable materials, demolition of any temporary/ permanent building/ structures/ foundations and removal of debris/ unsuitable material and disposing of unsuitable/ unserviceable material outside the premises with the permission of Engineer-in-charge.

3.1 SCOPE

This clause covers the design and execution of the work for site preparation, such as clearing of the site, the supply and compaction of fill material, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by stone (broken hard stone).

3.2 GENERAL

1) The bidder shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specifications.

2) If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be such a material and the site so designed as to prevent the erosion by wind and water of material from its final compacted position or the in-situ position of undisturbed soil.

3) Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material, approved by the Owner.

4) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by Owner.

3.3 EXCAVATION AND BACKFILL

1) Excavation and backfill for foundations shall be in accordance with the relevant code.
2) Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

3) When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.

4) Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15cm in thickness (of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Owner. Rocks larger than 10cm in any direction shall not be placed in embankment adjacent to structures.

5) Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

3.4 COMPACTION

1) The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Owner. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor’s density at OMC. The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor’s OMC. Cohesion less material sub-grade shall be compacted to 70% relative density (minimum).

2) At all times unfinished construction shall have adequate drainage. Upon completion of the roads surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

3) Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

3.5 REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils the fill materials and other protections etc. to be used under the foundation is to be got approved by the Owner.

4.0 ANTIWEED TREATMENT & STONE SPREADING

4.1 SCOPE OF WORK

4.2 The Bidder shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Owner. Stone spreading along with plain cement concrete & Crusher dust (residue of coarse aggregate)/ Quarry Rubbish/ Murram/ any locally available Non cohesive material having anti weeding property shall be done in the areas of the switchyard under present scope of work. However, the stone spreading along with Crusher dust (residue of coarse aggregate)/Quarry Rubbish/Murram/any locally available Non cohesive material having
anti weeding property in future areas within fenced area shall also be provided in case step potential without stone layer is not well within safe limits.

4.3 This work is to be taken up after the site is cleared off all vegetation and prepared to the levels and grades as per the approved drawing.

4.4 Engineer-in-charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

4.5 After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-incharge. The sub grade shall be consolidated by using half ton roller with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

4.6 In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments is not possible, the material shall be compacted by hand. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

4.7 Over the prepared sub grade, 100mm thick plain cement concrete in M15 grade CC1:2:4 with 100mm thick quarry rubbish/crusher sand having anti weed property shall be laid evenly, rolling and compaction. In cement concrete layer suitable expansion joints and slopes shall be maintained.

4.8 A final layer of 100mm thickness of uncrushed/crushed/broken stone of 20mm nominal size (ungraded size) shall be spread uniformly over CNS layer.

4.9 **Stone spreading for the areas of Future scope of work: Not Applicable.**

4.10 After the soil sterilization material is applied and surface prepared / compacted to the required slope/grade a base layer of 150mm Crusher dust (residue of coarse aggregate) / Quarry Rubbish / Murram / any locally available Non cohesive material having anti weeding property. Over the brick edging, 100mm thick layer of granite/basalt/trap jelly of 20mm size shall be spread over the entire switchyard area as per drawing and directions of engineer-incharge of the work

4.11 The 20mm nominal size shall pass 100% through IS. Sieve designation 40 mm and nothing through 16.00 mm IS Sieve. The whole switchyard area (excluding buildings pathway road, drainages, cable trenches, equipments/ structures plinths etc…) shall be covered with jelly spreading.

4.12 **GENERAL REQUIREMENT**

The material required for site surfacing/ stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Owner.

The material to be used for stone filling/ site surfacing shall be uncrushed/ crushed/ broken stone of 20mm nominal size (ungraded single size) conforming to table 2 of IS: 383 - 1970. Hardness, Flakiness shall be as required for wearing courses are given below:

<table>
<thead>
<tr>
<th>(a)</th>
<th>Sieve Analysis limits (Gradation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(IS: 383 - Table - 2)</td>
<td>% passing by weight</td>
</tr>
<tr>
<td>Sieve Size</td>
<td>100</td>
</tr>
<tr>
<td>40 mm</td>
<td>85-100</td>
</tr>
<tr>
<td>20 mm</td>
<td>0-20</td>
</tr>
<tr>
<td>10 mm</td>
<td>0-5</td>
</tr>
<tr>
<td>4.75 mm</td>
<td></td>
</tr>
</tbody>
</table>

‘One Test’ shall be conducted for every 500 cu.m.
<table>
<thead>
<tr>
<th>(b)</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion value (IS:2386 Part-IV)</td>
<td>Not more than 40%</td>
</tr>
<tr>
<td>Impact value (IS: 2386 Part-IV)</td>
<td>Not more than 30% and frequency shall be one test per 500 cum with a minimum of one test per source.</td>
</tr>
</tbody>
</table>

| (c) | Flakiness Index: One test shall be conducted per 500 cum of aggregate as per IS: 2386 Part-1 and maximum value is 25%. |

4.13 After all the structures/equipments are erected, antiweed treatment shall be applied in the switchyard where ever stone spreading is to be done and the area shall be thoroughly deweeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used. The antiweed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10MX10M (aprx) and shall be sprinkled with water at least once in the afternoon every day after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer incharge. The final approval shall be given by Engineer incharge based on the results.

4.16 The dosage and application of chemical shall be strictly followed as per manufacturer's recommendation. The Bidder shall be required to maintain the area free of weeds for a period of 1 year from the date of application of 1st dose of anti-weed chemicals.

4.17 CEMENT CONCRETE BLOCK MASONRY BARRICADES (KERB STONE):

4.18 Barricades in solid concrete block masonry in cement mortar 1:6 with concrete blocks of proportion (1:1:5:3), crushing strength not less than 50 kgs per sq. cm, 40x20x40cm size(L.B.H) conforming to ISS : 2185 –1987 to confine stone spreading and along road side kerb stone shall be provided. The masonry shall be 550mm above FGL, plastered in cement mortar 1:6 and shall be given two coats of weather proof painting over primer to the exposed faces.

5.0 SITE DRAINAGE

1) Adequate site drainage system shall be provided by the Bidder. The Bidder shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate run off due to the most intense rainfall that is likely to occur over the catchment area in one hour period on an average of once in ten years. The surface of the site shall be sloped to prevent the ponding of water.

2) The maximum velocity for pipe drains and open drains shall be limited to 2.4 m/sec and 1.8 m/sec respectively. However, minimum non silting velocity of 0.6m/sec shall be ensured. Longitudinal bed slope not milder than 1 in 1000 shall be provided.

3) For design of RCC pipes for drains and culverts, IS: 456 and IS: 783 shall be followed.

4) The Bidder shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts etc. to prevent erosion of material by water.

5) The drainage system shall be adequate without the use of cable/ pipe trenches. (Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation).

6) For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards or at least NP4 class shall be provided. Manholes shall be provided at every 30m interval, at connection points and at every change of alignment.
7. Surface drains with suitable size removable light duty covers shall be provided using Stone/Brick masonry with minimum thickness of 300/230 mm or more as per design condition.

8. Pipe drains shall be connected through manholes at an interval of max. 30m. Effluents shall be suitably treated by the Bidder to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.

9. Invert of the drainage system shall be decided in such a way that the water can easily be discharged above in High Flood Level (HFL) outside substation boundary at suitable location upto a maximum 50M beyond boundary wall of substation or actual whichever occurs earlier and approved by Owner. Pumps for drainage of water (if required) shall be provided by Bidder.

10. All internal site drainage system, including the final connection/ disposal to Owner’s acceptance points shall be part of Bidder’s scope including all required civil work, mechanical & electrical systems. The Bidder shall connect his drain(s) at one or more points to outfall points as feasible at site.

11. The drainage scheme and associated drawings shall be got approved.

6.0 ROADS AND CULVERTS

1) The approach road and road within substation shall be provided for access to equipment and building are in the scope of bidder. Layout of the roads shall be based on General detail & Arrangement drawing for the substation. Parking areas shall be provided for Site personnel and visitors at convenient locations. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the transformer/ Reactor shall be as short and straight as possible.

2) All substation roads are constructed so as to permit transportation of all heavy equipment. The transformer track road shall have minimum 4.00 m wide cement concrete road with 1.6 m wide morrum shoulder& kerb stone on both side of road. Outer side road of 220 kv & 33 kv yard shall be 3.00 m wide road with 1.3 m wide morrum shoulder and kerb stone on both sides. Inspection path roads shall be 3.00 m wide cement concrete road. Existing Main road shall be connected to main entry gate of PSS with suitable curve for turning space of vehicles including kerb stone on both side of road, if required.

3) Road construction shall be as per IRC standards.

4) Adequate provision shall be made for road drainage.

5) All the culverts and its allied structure (required for road/ rail, drain trench crossing etc.) shall be designed for class AA loading as per IRC standard/ IS code and should be checked for transformer/ Reactor loading.

6. All roads shall be designed for class ‘E’ of traffic as per IRC-37-1984 Guide lines for the design of flexible pavements.

7.0 FOUNDATION/RCC CONSTRUCTION

7.1 GENERAL

1) Work covered under this clause of the specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, control cubicles, bus supports, Transformer/ Reactors, marshalling kiosks, auxiliary equipments & systems buildings, tanks or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.
2) Concrete shall conform to the requirements mentioned in IS: 456-2000 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification

A minimum grade of M20 concrete shall be used for all structural/ load bearing members as per latest IS 456-2000.

3) If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

4) The switchyard foundation's plinths and building plinths shall be minimum 400 mm and 1000mm above finished ground level respectively.

5) Minimum 150 mm thick lean concrete M7.5 (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction. Minimum 300mm thick compacted layer of quarry rubbish/morrum shall be provided under lean concrete.

6) Concrete made with Ordinary Portland cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

7) The design and detailing of foundations shall be done based on the approval soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof.

7.2 DESIGN

1) All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS:456 & minimum grade of concrete shall be M-20.

2) Limit state method of design shall be adopted unless specified otherwise in the specification.

3) For detailing of reinforcement IS: 2502 and SP:34 shall be followed. Cold twisted deformed bars (Fe=415/500 N/mm2) conforming to IS:1786 shall be used as reinforcement. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness of 150 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.

4) RCC water retaining structures like storage tanks etc. shall be designed as un-cracked section in accordance with IS: 3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.

5) The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/ or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS Codes of foundation design.

6) Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

7) Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/ harmful to the concrete foundations.

8) RCC columns shall be provided with rigid connection at the base.

9) All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically
above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

10) Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

11) In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc. for the vehicular traffic in the vicinity of the structure.

12) Following conditions shall be considered for the design of water tank in pump house, channels, sumps, trenches and other underground structures.
   (a) Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (application only to structures which are liable to be filled up with water or any other liquid).
   (b) Full earth pressure, surcharge pressure and ground water pressure from outside & no water pressure from inside.
   (c) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

13) Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

14) Base slab of any underground enclosure like water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pumps sump being empty for maintenance.

15) The foundations shall be proportioned so that the estimated total & differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

16) The foundations of transformer/ reactor and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

17) The tower and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factors shall be used as partial safety factor over loads in limit state design also.

7.3 **ADMIXTURES & ADDITIVES**

1) Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.

2) Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Concrete Admixtures/ Additives shall be approved by Owner.
3) The Bidder may propose and the Owner may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

4) The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.

5) The water proofing cement additives shall be used as required/advised by the Owner.

8.0 TRANSFORMER FOUNDATION, RAIL TRACK/ ROAD CUM RAIL TRACK.

The Bidder shall provide a RCC Rail cum road system integrated with the transformer/ Reactor foundation to enable installation and the replacement of any failed unit by the spare unit located at the site. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with integral radiators and oil, without the deenergization of any other equipment in the station. This system shall enable the removal of any failed unit from its foundation to the nearest road. If trench/ drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with I.R.C. code/ relevant IS.

The rail shall be of commercial quality flat bottom.

A pylon support system shall be provided for supporting the fire fighting system by the Bidder.

8.1 DESCRIPTION OF OIL RECOVERY SYSTEM

The oil recovery system shall be provided for all Transformer/Reactors (containing insulating oil or any inflammable or polluting liquid) in order to avoid spread of fire by the oil, and for environmental protection.

Each transformer/ Reactor including oil conservator tank and cooler banks etc. shall be placed in a self sufficient pit surrounded by retaining walls (Pit walls). The clear distance of the retaining wall from the transformer/ Reactor shall be 20% of the transformer/ Reactor height or 0.8 m whichever is more. The oil collection pit thus formed shall have a void volume equal to 200% volume of total oil in the Auto transformer/ Reactor. The MS grating placed at the formation level shall be covered with 100 mm thick layer of broken/ crushed/ non crushed stone 40 mm nominal size which acts as an extinguisher for flaming oil.

Each oil collection pit shall be drained towards a sump pit within the collection pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry & clean.

8.2 MATERIALS

The retaining walls which make up the oil collection pit shall be made of fire resistant material such as reinforced cement concrete, fire brick etc., and shall be impervious to oil.

The minimum height of the retaining walls shall be 15 cm above the finished level of the ground to avoid outside water pouring inside.

The bottom of the pit shall have a uniform slope towards the sump pit.

8.3 DRAINAGE

A device showing level of sump pit shall be provided by Bidder fitted along with the automatic pumping system which shall have sufficient capacity to evacuate the fire fighting & rain water from the sump pit. The Bidder may propose other better scheme, if agreed by Owner.
If the heights of the retaining walls which form the oil collection pit exceed 60 cm, steps shall be provided to facilitate access to the oil collection pit.
When designing the oil collection pit, the movement of the Transformer must be taken into account.

9.0 CABLE & PIPE TRENCHES

1) The cable trenches in switch yard shall be constructed using stone masonry with base cement concrete and precast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade.

2) The cable trench walls shall be designed for the following loads.
   (i) Dead load of 155 kg/m length of cable support + 75 Kg on one tier at the end.
   (ii) Triangular earth pressure + uniform surcharge; pressure of 2T/m².

3) Cable trench covers shall be designed for self weight of top slab + UDL of 2000 Kg/m² + concentrated load of 200 kg at centre of span on each panel.

4) Cable trench crossing the road/ rails shall be designed for class AA. Loading of IRC/ relevant IS code and should be checked for transformer/ reactor loading.

5) Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.

6) The top of trenches shall be kept at least 300 mm above the finished ground level. The top of cable trench shall be such that the surface rain water do not enter the trench.

7) All metal parts inside the trench shall be connected to the earthing system.

8) Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

9) The trench bed shall have slope of 1/200 along the run & 1/50 perpendicular to the run.

10) All the construction joints of cable trenches i.e. between base slab to base slab and the junction of vertical wall to base slab as well as from vertical wall to wall and all the expansion joints shall be provided with approved quality PVC water stops of approx. 230 x 5 mm size for those sections where the ground water table is expected to rise above the junction of base slab and vertical wall of cable trenches.

11. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm thick 1:6 cement sand mortar.

12) Cable tray’s be provided in required tiers to lay the control cables in cable trenches supported with the design data and approved by the RSDCL.

13) Cable from main trench to equipment shall run in D type trench.

10.0 SECURITY ROOM

A security room (Guard hut) shall be constructed at the entrance of each GSS. The minimum dimension of the room and associated toilet and pantry etc. is given on the drawing.

11.0 BOUNDARY WALL

All premises of Grid Sub Station shall be covered by constructing Boundary wall of Brick masonry of 1800mm height and 350mm thick above plinth level. Stone masonry shall be used up to plinth level. At plinth level 150mm thick RCC bend shall be provided for strengthening. In Boundary wall 450mm thick pillar at centre of every 3.00m and expansion joint at every 15.00m distance shall be provided. At top of Boundary wall a suitable railing in front of control room bldg.and Y-shape angle with GI barbed wire at other
three sides shall be provided. Main Boundary wall gate of 6500mm length with vicket gate of 1200mm length shall be provided near Security hut. Cattle catcher shall be provided outside of vicket gate. Plaster in cm 1:6 on stone/Brick masonry shall be done on both sides. At top of Boundary wall masonry 75mm thick RCC coping in cement mortar 1:1.5:3 shall be provided and all plastered surface shall be painted by approved water proof paint/Textured paint. MS Railing & Y-Shape angle shall be painted with approved steel primer and synthetic enamel paint.

12.0 BUILDINGS - GENERAL REQUIREMENTS

12.1 GENERAL

The scope include the design, engineering and construction including anti-termite treatment, plinth protection DPC of Building including sanitary, water supply, electrification false ceiling etc. of control room building, AC Kiosk building, fire fighting building. All buildings shall be of RCC framed structure of concrete of M20 grade minimum.

12.2 CONTROL ROOM & REST ROOM BUILDING

Minimum floor area requirements have been given in tender drawings which may be increased at the time of detailed engineering to suit project requirements.

An open space of 1 m minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

Any future possibility of annex building shall be taken care of while finalizing the layout of the control room building.

12.2.1 DESIGN

(a) The buildings shall be designed:

1) To the requirements of the National Building Code of India, and the standards quoted therein.
2) For the specified climatic & loading conditions.
3) To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
4) With a functional and economical space arrangement.
5) For a life expectancy of structure, systems and components not less than that of the equipment which is contained in the building provided regular maintenance is carried out.
6) To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
7) To allow for easy access to equipment and maintenance of the equipment.
8) With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
9) With materials preventing dust accumulation.

(b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

(c) Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force torsion etc.

(d) Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

(e) All cable vaults shall be located above ground levels i.e. cable vaults shall not be provided as basements in the buildings.
(f) The building lighting shall be designed in accordance with the requirements of relevant section. All conduit system, air conditioning tubing etc. shall be properly cared prior to concreting/finishing work. Complete wiring for lighting, air conditioning, intercom, broadband etc. shall be in GI concealed conduit during concreting or plaster what so ever be case.

(g) The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems & all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this specification.

(h) Two nos. emergency exists shall be provided in control room in control room building.

(i) Providing plinth protection of 1200 mm wide, along the periphery of control room

12.2.2 DESIGN LOADS

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads and temperature loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/ hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

The wind loads shall be computed as per IS 875, Seismic Coefficient method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for the purpose shall be taken as the difference between the mean of daily maximum temperature during the coldest month of the year and mean of daily maximum temperature during hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/ slabs shall be designed to carry loads imposed by equipment, cables piping travel of maintenance trucks and equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads, shall also be considered additionally for floors where these loads are expected.

In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Owner's approval.

For consideration of loads on structures, IS: 875, the following minimum superimposed live loads shall, however, be considered for the design.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roof</td>
<td>1.5 KN/M²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.75 KN/M²</td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RCC-Floor</td>
<td>(i) 5KN/M²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) 10KN/M²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(minimum.)</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toilet Rooms</td>
<td>2 KN/M²</td>
</tr>
</tbody>
</table>
Any additional load coming in the structure shall be calculated as per IS: 875

12.2.3 SUBMISSION

The following information shall be submitted for review and approval to the Owner:

1) Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.

2) Structural design calculations and drawing (including construction/ fabrication) for all reinforced concrete and structural steel structures.

3) Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:50 and shall identify the major building components.

4) Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

5) Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

6) A detailed schedule of building finishes including colour schemes.

7) A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

12.2.4 FINISH SCHEDULE

The finishing schedule is given in subsequent clauses.

12.2.5 FLOORING

Flooring in various rooms of control room building shall be as for detailed schedules given in Table-1.

12.2.6 WALLS

Control room buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 300 mm R.R. stone masonry/ 230 mm Brick masonry in 1:6 cement sand mortar.

12.2.7 PLASTERING

All internal & external walls shall have minimum 20 mm thick 1:6 cement sand plaster. The ceiling shall have 6 mm thick 1:4 cement sand plaster.
### Internal finish schedule, Table - 1:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Location</th>
<th>Flooring &amp; skirting 150 mm high</th>
<th>Wall Internal</th>
<th>Ceiling</th>
<th>Doors &amp; windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Control Room, PLCC Room, Battery Room,</td>
<td>Vitrified tiles 600 x 600 10 mm thick Homogeneous</td>
<td>All walls shall be prepared with POP/Cement putty &amp; Plastic Emulsion paint of approved quality.</td>
<td>Calcium silicate board false ceiling size of tiles 595 x 595mm including frame work made of power pressed from MS Sheet and galvanized in accordance with zinc coating.</td>
<td>Anodized Aluminum Jindal or equivalent extruded sections as per IS 733 &amp; 1285 glazing with 5.00mm toughened glass Hermetically sealed with 12 mm gap. Aluminum expanded grill at exterior face of all door, window &amp; ventilators.</td>
</tr>
<tr>
<td>2.</td>
<td>Rest Room, dining room, Sub-station in charge officers, corridor, staff rooms, Reception/Entrance</td>
<td>Same as 1</td>
<td>Same as 1</td>
<td>False ceiling in Rest rooms, dining room, Substation in charge room and Plastic emulsion paint in other offices.</td>
<td>Teak wood frame &amp; flush door shutter, &amp; windows, ventilators Aluminum Jindal or equivalent extruded sections as per IS 733 &amp; 1285 glazing with 5.00mm toughened glass hermetically sealed with 12mm gap. Aluminum expanded grill at exterior face of all door, window &amp; ventilators.</td>
</tr>
<tr>
<td>3.</td>
<td>Toilet</td>
<td>Ceramic floor tiles of apprd. make &amp; quality</td>
<td>DADO glazed tile 2.1 M high for toilet for pantry above working platform upto 750 mm</td>
<td>Plastic Emulsion paint</td>
<td>Teak wood frame flush door shutter &amp; windows, ventilators aluminum as at 1</td>
</tr>
<tr>
<td>4.</td>
<td>Stair &amp; Pantry</td>
<td>Vitrified Tile/combination of Green Kesaria marble/Jaisalmer stone/Wonder marble</td>
<td>-</td>
<td>Plastic Emulsion paint</td>
<td>Stainless steel Railing of approved design</td>
</tr>
<tr>
<td>5.</td>
<td>Store shed</td>
<td>Kota stone flooring 50mm thick</td>
<td>Plastic Emulsion paint</td>
<td>Plastic Emulsion paint</td>
<td>Steel section window with glass panes of approved design &amp; Steel rolling shutter of approved make</td>
</tr>
<tr>
<td>6.</td>
<td>Dormitory</td>
<td>Vitrified tile 600 x 600 mm</td>
<td>Plastic Emulsion paint</td>
<td>Plastic Emulsion paint</td>
<td>Teak wood frame flush door shutter &amp; Aluminum window same as 1</td>
</tr>
<tr>
<td>6.</td>
<td>Security Hut</td>
<td>Vitrified tile flooring</td>
<td>Plastic Emulsion paint</td>
<td>Plastic Emulsion paint</td>
<td>Steel section window with glass panes of approved design</td>
</tr>
</tbody>
</table>
Exterior finish
Textured Paint after application of cement putty and primer over the areas of plastered surface.

11.2.8 **ROOF**

Roof of the C.R. Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment confirming to PWD specification (item No. 25.8 of DSR 1997). The water proofing treatment shall be of following operations:

(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m² of cement admixed with proprietary water proofing compounds conforming to IS; 2645 over the RCC slab including cleaning the surface before treatment.
(b) Over RCC roof grading shall be done by using M-10 grade mix 1:3:6 (1 cement : 3 course sand: 6 graded stone aggregate) in proper slop with average thickness of 80 mm and minimum thickness at Khurra 40 mm.
(c) 20 mm thick Terrazzo to tiles with grinded be provided in cm 1:4 over graded roof.
(d) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

13.0 **CHAIN LINK FENCES AND GATE**

13.1 **General:** Fencing shall be provided as per the drawings/ details furnished by the owner.

13.2 **Areas requiring Fencing:**

Fencing shall be provided all along the boundary covering the entire switch yard in main and wicket gate as per drawing. Drawing shall be developed as per the typical sketch furnished.

13.3 **(a) Product Materials:** The minimum requirements are as follows:

1) Chain Link fence fabric in accordance to IS: 2721.
2) Size of mesh 50 mm.
3) Size of coated wire 4 mm diameter (8 gauges)
4) Width of chain link 2500 mm
5) Class of zinc coating medium

(b) **Posts**

<table>
<thead>
<tr>
<th></th>
<th>Angle section</th>
<th>Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Intermediate</td>
<td>50 x 50 x 6mm</td>
<td>2500 mm</td>
</tr>
<tr>
<td>(2) Straining posts / Corner posts</td>
<td>50 x 50 x 6mm</td>
<td>25000 mm</td>
</tr>
<tr>
<td>(3) Stay post</td>
<td>50 x 50 x 6mm</td>
<td>25000 mm</td>
</tr>
</tbody>
</table>

All structural steel shall conform to IS: 2062 and shall be painted with a coat of approved steel primer and two coats of synthetic enamel paint.

Chain link mesh shall be connected/fixed to the posts by providing ISA 50x 50 x 6 mm horizontally at the top and center (middle) throughout the length of fencing and MS Flat 50 x 6 mm vertically at every posts. Connection of Angle and MS flat & chain link mesh with the posts shall be with suitable bolts and nuts or Welding as per the direction of the Owner/ Engineer-in-charge of work.

The bottom of chain link mesh shall be embedded in CC 1:2:4 to a depth not less than 100 mm.

(4) Above chain link, 4 rows (9 Nos.) of galvanized barbed wire, conforming to IS: 278 shall be provided in each arm of the 'Y' shaped barbed arm at top. The barbed wire shall consist of
two splices per reel. The barbed wire shall be formed by twisting two line wires, one containing the barbs. The barbed wire shall be of 12 SWG galvanized steel with its weight 155-136gm/m length of the wire. Distance between two barbs shall be 75 mm. The barbs shall carry four points and shall be formed by twisting two point wires, each two turn tightly round one line wire, making altogether 4 complete turn. The barbs shall be finished in such a way that the four points are set and locked at right angles to each other. The barbs shall have a length of not less than 13 mm and not more than 18 mm. The points shall be sharp and well pointed.

(5) With barbed wire above the chain link fence, the total fence height shall be minimum 3200 mm above finished ground level or 3000 mm above the protection work as the case may be.

(6) Barbed wire arms same as intermediate and straining post.

(7) Fittings and hardware: cast aluminum alloy or galvanized steel, malleable or ductile cast iron turnbuckles to be drop forged.

(8) For every 50 reels or part thereof samples of the barbed wire and the individual line wires shall be put to tensile test and in case of failure to conform to the tensile properties given below, two additional tests of each kind shall be made on the samples cut from other reels.

**TENSILE PROPERTIES**

Minimum breaking load of complete barbed wire: 444 Kg.

On the results of these additional tests, the whole or portion of the barbed wire shall be accepted or discarded by the Owner, as the case may be.

13.4 **INSTALLATION:**

1) Fence shall be installed along lines shown on approved drawings.
2) Post holes shall be excavated by approved methods.
3) Intermediate posts shall be spaced 2.5 m apart measured parallel to ground surface.
4) Straining posts shall be installed at equal interval not exceeding 25.0m.
5) Straining posts shall be installed at sharp changes grade, at corners, at change of direction and where directed.
6) All corner post and every 10th post will have two stay post.
7) Posts shall be set in concrete. Concrete work shall conform to relevant clause. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has set.
8) Fence fabric shall not be installed until concrete has cured a minimum of 10 days.
9) Top and center (middle) of the fence fabric shall be fixed with ISA 50x50 x 6 mm.
10) Fence fabric shall be laid out with barbed edge on top, stretched tightly and shall be fastened to intermediate, gate and straining post with 50x 6 mm M.S flats(vertical at every post) and horizontal angle 50 x 50 x 6 mm throughout the fence at top and middle.
11) Fabric shall be fixed to the angle and MS flat by welding or suitable G.I bolts, nuts and washers and at bottom the fabric shall be embedded in concrete.
12) Barbed wire shall be stretched to have uniform tension.
13) Barbed wire shall be attached to barbed wire arms with approved metal clips.
14) Gates shall be installed in locations shown on drawings. Next to the main gate, a men gate (1.25 m wide, single leaf) shall also be provided.
15) Bottom of gates shall be set approximately 50 mm above ground surface & necessary guiding mechanism shall be fitted,
16) Drawing for the gate shall be as per the typical sketch furnished.
17) All structural steel shall be painted with two coats of approved synthetic enamel paint over one coat of steel primer.
18) **(a) For providing fencing over ground:**
A 300 mm thick size stone masonry toe wall shall be provided below fencing. Toe wall shall be minimum 450 mm, above and 600 mm below finished ground level with 150mm thick PCC 1:4:8 bed concrete and 100 mm thick PCC 1:2:4 coping for embedding chain link fence. All exposed faces of masonry shall be plastered in cement mortar 1:6 and painted by approved water proof paint./textured paint.

(b) For providing fencing over retaining wall /protection wall:

The excess quantities of different items of work of construction of retaining wall over and above the quantities applicable for construction of toe wall of security fencing as per drawing will be measured and paid under construction of retaining wall/protection wall.

19) In case of B.C./Expansive soil and filled up soils, masonry wall shall be strengthened to overcome the effects of soil on foundation and to avoid settlements.

20) For expansive/BC soil, back filling shall be with new earth/murrum.

14.0 GATES:

1) The Gate frame shall be made of medium duty MS pipe conforming to relevant IS with welded joints.

2) The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.

3) Gates shall be fitted with approved quality iron hinges, latch and latch catch. Latch & latch catch shall be suitable for attachment and operation of pad lock from either side of gates. Hinges shall permit gates to swing through 180 degree back against fence.

4) Gates shall be fitted with galvanized chain hook or gate hold back to hold gates open. Double gates shall be fitted with centre rest and drop bolt to secure gates in closed position.

5) Drawings shall be developed as per the typical sketch furnished and got it approved.

15.0 GLAZING

Minimum thickness of glazing shall be 5.0 mm as per IS: 2835. Sun film shall be provided for all windows/doors for AC rooms.

15.1 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule Table-1 and tender drawing with the relevant IS, code, Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in PWD/RVPN, specification.

15.2 PARTITION

Partition made of anodized aluminum frame provided with 5.0 mm thick clear glass shall be supplied and installed at locations shown in tender drawings.

15.3 PLUMBING & SANITATION

(i) All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Bidder shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.
(ii) PVC syntax or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 3 Nos. 1000 litres capacity shall be provided.

(iii) Galvanized MS pipe of medium class conforming to IS:1279 shall be used for internal & external piping work for potable water supply.

(iv) SWR/Rigid PVC pipes with rubber rings and solvent cement joints conforming to IS:13592 shall be used for sanitary works.

(v) Each toilet shall have the following minimum fittings:
   (a) WC (Western type wall hung) 390 mm high with toilet paper roll holder and all fittings.
   (b) Wash basin (550x400 mm) with all fittings.
   (c) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
   (d) CP brass towel rail (600 x 20mm) with C.P. brass brackets
   (e) Soap holder and liquid soap dispenser.

(vi) Water cooler for drinking water with PVC loft tank shall be provided and located near control room instead of near toilet block.

(vii) 1No. Stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

(viii) All fittings, fastener, grating shall be chromium plated.

(ix) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the manufacturer.

(x) Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load.

16.0 PARKING

16.1 An architecturally pleasing Parking shed of RCC pavement and roof slab to accommodate 06 Cars including proper illumination shall be provided as per tender drawing/ approved drawing.

17.0 BUILDING STORM WATER DRAINAGE FOR ALL BUILDINGS

The building drain shall be provided for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station.

Cast Iron rain water down comers conforming to IS: 1230 with water tight lead joints shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement concrete or cladding material. The number and size of down comers shall be governed by IS: 1742 and IS: 2527.

For all buildings, suitable arrangement for draining out water collected from equipment blow down, leakages, floor washings fire fighting etc. shall be provided for each floor.

18.0 MISCELLANEOUS GENERAL REQUIREMENTS

18.1 Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.
18.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

18.3 All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanized structures and shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.

18.4 A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS: 456-1978 shall be provide below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

18.5 Bricks having minimum 75 kg/cm² compressive strength can only be used for masonry work. Bidder shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm² compressive strength before submitting his offer.

18.6 Doors and windows on external walls of the buildings (other than areas provided with insulated metal claddings) shall be provided with RCC sun-shade over the openings with 300 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 600 mm over window openings and 900 mm over door openings.

18.7 Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.

18.8 For all civil works covered under this specification, design mix by batching as per PWD specification is intended. However, for small quantities of concreting, Nominal mix shall be allowed at the discretion of Engineer-in-charge with relationship of grade of concrete and ratio of ingredients as below:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Mix</th>
<th>Cement</th>
<th>Sand</th>
<th>Coarse aggregate of 20mm down grade as per IS 383</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M 7.5</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td>M 10</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>M 15</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>M 20</td>
<td>1</td>
<td>1.5</td>
<td>3</td>
</tr>
</tbody>
</table>

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of PWD specification and approved standard Field Quality Plan.

18.9 The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.

18.10 Items/ components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

19.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/ walls/ floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/ embedment’s, provision of cutouts etc. shall be the sole responsibility of the Bidder. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.
20.0 **WATER SUPPLY**

(i) Water shall be made available by bidder during construction.
(ii) The Bidder shall also carry out all the plumbing/erection works required for supply of water in control room building, Dormitory, security hut and in switchyard near Transformers etc.
(iii) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.
(iv) Bore wells for water supply is not in the scope of Bidder.
(v) The contractor shall construct Underground water storage tank as per approved drawing to cater water supply for main water supply system. A 2 HP submersible water electric motor shall be provided by the contractor.

21.0 **SEWERAGE SYSTEM**

(i) Sewerage system shall be provided for control room building, Dormitory & Security hut.
(ii) The Bidder shall construct septic tank, soak pit suitable for control room building, dormitory and security hut separately.
(iii) The system shall be designed as per relevant IS Codes.

22.0 **INTERLOCKING BLOCKS**

Precast concrete interlocking blocks of M30 grade 100mm thick manufactured from fully computerized automatic stationary hydraulic vibropressed machine and fully computerized automatic batching plant of class A1/A2 as per BS 6717:2001. The CC interlocking paving blocks be laid on average 50mm thick bed of coarse sand and the joints is to fill with fine sand. Laying procedure on compacted sub-base as defined whenever required near the control room bldg and dormitory.

23.0 **DORMITORY**

1No. fully furnished Dormitory shall be constructed by Bidder in each PPS premises to reside the O&M staff of PSS. It will have minimum plinth area about 17600 mm x 15000 mm=264.00 sq. meter at Ground floor. It shall have 2 Nos. Halls, 1 No kitchen cum dining room, toilet block (including 2 Nos. W.C, 2 Nos. bath rooms) and other required facilities at Ground floor. It will have 4Nos. bed rooms with attached toilet and care taker cum store at first floor. 16 Nos. wardrobe/Almirah in both halls shall be constructed with Kota stone/ sand stone shelves and godrej shutter in each hall. Wardrobe/Almirah shall be constructed also in bedrooms, kitchen cum dining room, store and care taker room with all required accessories. It shall be furnished as per approved design/drawing. The technical specification of Building work, sanitary, electric work shall be same as Control room bldg and approved design/drawings.

24.0 **SIGN BOARD**

Two Nos. sign boards at each GSS shall be provided by the bidder as per detail given here under:

(i) 1 No. on the roof of Control Room Building which shall be glow sign board of size (6.00m x 1.50m) with all required electric lighting system as per enclosed drawing.
(ii) 1 No. painted sign board at outside the main entrance Gate of PPS having M.S. pipe frame as per drawing enclosed.

25.0 **Park or Lawn:**

A Park/Lawn of size 30.0 m x 12.0 m with 0.60m height boundary wall and 0.60 m height M.S. Railing in front of Control room building shall be constructed as per approved design/drawing. Lawn along with small flowers shall be developed in the Park.
26.0 **STATUTORY RULES**

26.1 Bidder shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State), Fire Safety Rules of Tariff Advisory Committee & Water Act for pollution control etc.

26.2 Provisions for fire proof doors, No. of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.

26.3 Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

26.4 Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

26.5 Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS: 1904 and other Indian Standards.

26.6 All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS: 3370 (Part-1).

26.7 Construction joints shall be as per IS: 456-2000

26.8 All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS: 9103. In addition, limit on permeability as given in IS: 2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/ damp proofing.

In case of water leakage in the above structures, Injection Method shall be applied for repairing the leakage.

26.9 All building/ construction materials shall conform to the best quality specified in PWD specifications if not otherwise mentioned in this specification.

26.10 All tests as required in the standard field quality plans have to be carried out.
### SPECIFICATION OF FURNITURE FOR CONTROL ROOM (GODREJ MAKE)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Item</th>
<th>Specification</th>
<th>Quantity (In Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Office Table</strong>: Size: W-1670 mm, D-900 mm &amp; H-750 mm, containing Double coated paint, Double storage unit i.e. (i) 3-Drawer unit, (ii) 1-Box unit and 1-File cover unit, Square tubular under structure &amp; Modesty panel.</td>
<td></td>
<td>2 2 2 2</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Ordinary Chair</strong>: (Full Armed) Size: 58 mm W x 57 mm D x 88 mm H plus seat height 45 having powder coated paint, seats &amp; backs seamlessly mounted with wood &amp; Steel, tubular Frame work, with spring effect of cantilever in chair.</td>
<td></td>
<td>13 13 13 13</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Steel Side Rack</strong>, Size 2.5’ H, 15” W, 3’ D.</td>
<td></td>
<td>2 2 2 2</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Steel Stool</strong></td>
<td></td>
<td>4 4 4 4</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Steel revolving chair with 5 legs for in charge of GSS and shift Engineer</strong></td>
<td></td>
<td>2 2 2 2</td>
</tr>
</tbody>
</table>
### ANNEXURE-2

**SPECIFICATION OF FURNITURE FOR REST ROOMs & DINING HALL (GODREJ MAKE)**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Item</th>
<th>Qty. (in Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Single Bed with melamine polish without Box &amp; without Mattress size 6’  3” X 3’</strong></td>
<td>6 Nos.</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Bed sides Table with one drawer with melamine polish Size 36” X 18” X 18”</strong></td>
<td>6 Nos.</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Centre Table with Four Leg in melamine polish. Size 36” X 18” X 18”</strong></td>
<td>3+1 Nos.</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Easy Chair (Armed).</strong></td>
<td>6+4 Nos.</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Mattresses sleep well or equivalent Make - 32 densities.</strong></td>
<td>6 Nos.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Pillow sleep well or equivalent Make - 40 density.</strong></td>
<td>6 Nos.</td>
</tr>
<tr>
<td>8.</td>
<td><strong>Pillow covers cotton Size 27’ X 17’</strong></td>
<td>12 Nos.</td>
</tr>
<tr>
<td>9.</td>
<td><strong>Blanket of OCM/ Bombay Dying or equivalent</strong></td>
<td>06 Nos.</td>
</tr>
<tr>
<td>10.</td>
<td><strong>Sofa sets including good quality tapestry cloth 3 – Sealer.</strong></td>
<td>3+1 Nos.</td>
</tr>
<tr>
<td>11.</td>
<td><strong>Wooden side Table Melamine polish Size 2’ X 2” x 18”</strong></td>
<td>3 Nos.</td>
</tr>
<tr>
<td>12.</td>
<td><strong>Wooden Cushion Chairs with Polish.</strong></td>
<td>3 Nos.</td>
</tr>
<tr>
<td>13.</td>
<td><strong>Dining Table (6”x 3”x3” ) with 6 chairs</strong></td>
<td>1 set</td>
</tr>
</tbody>
</table>

*Note: PPS-I, PPS-II, PPS-III, PPS-IV represent different brands or specifications.*
## SPECIFICATION OF FURNITURE FOR DORMITORY (GODREJ MAKE)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Items</th>
<th>QTY (IN NOS.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PPS-I</td>
</tr>
<tr>
<td>1.</td>
<td>Dining Table (Rectangular Top)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Size: 1200 x 750 x 750 mm (L x W x H)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Top made pot 25mm thick laminated Ply board with post formed finish. Base made out with M.S. Pipe structure chrome plated finish.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Dining Chair or Visitor chair without Arms, Pipe frame, fabric Tapestry</td>
<td>8 +1+4</td>
</tr>
<tr>
<td>3.</td>
<td>Single Bed: 1875 x 900 x 750 mm</td>
<td>16 +9</td>
</tr>
<tr>
<td></td>
<td>Bed structure made out with M.S. pipe 25 x 25 mm square pipe. All bed cover with 18mm thick pre laminated particle board with FSEB finish.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Study Table</td>
<td>1+4</td>
</tr>
<tr>
<td></td>
<td>Size: 950 x 535 x 750 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Top made out with 25mm thick laminated particle board with FSEB finish. Rest structure 18 mm thick pre laminated particle board FSEB finish.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Mattress: sleep well or equivalent make 32 density</td>
<td>16 +9</td>
</tr>
<tr>
<td>6.</td>
<td>Pillow: sleep well or equivalent make 40 density</td>
<td>16 +9</td>
</tr>
<tr>
<td>8.</td>
<td>Pillow Cover: Cotton size 27’ x 17’</td>
<td>32 +18</td>
</tr>
<tr>
<td>9.</td>
<td>Blanket: Bombay Dying or equivalent</td>
<td>16 +9</td>
</tr>
</tbody>
</table>

## WATER COOLER WITH R.O. (1 No. at each PPS & each Dormitory)

### (A) WATER COOLER

Voltas, Blue Star or equivalent Standard make with following Specifications:

- Cooling Capacity: 40 litres/hour
- Compressor Motor: 1.3 HP
- Condenser Fan Motor: 1.32 HP
- Full Load Current: 3.6 Amps
- Rate of Max. Energy Consumption: 600 Watts
- Refrigerant: R12-100Kg
- Test Pressure: 18 Kg.cm²

### (B) R.O.

- Purification capacity: 50 Litre/Hr.
- Make/Model: Kent, Kent Elite-II
### SPECIFICATIONS FOR RESIDENTIAL & NON RESIDENTIAL BUILDINGS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEM</th>
<th>TYPE OF BUILDINGS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CONTROL ROOM &amp; DORMITORY</td>
<td></td>
</tr>
<tr>
<td><strong>A: Building Work:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.(a)</td>
<td>Base concrete (Foundation)</td>
<td>Cement concrete 1:4:8 using 40 mm crusher broken aggregate.</td>
<td>Min. thickness of base concrete shall be 150 mm</td>
</tr>
<tr>
<td>(b)</td>
<td>Base concrete (under floor)</td>
<td>Cement concrete 1:4:8 using 40 mm crusher broke aggregate in (100 mm thickness).</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Foundation masonry</td>
<td>RR stone/brick masonry in cement sand mortar 1:6</td>
<td>Brick masonry be allowed where good quality stone is not available.</td>
</tr>
<tr>
<td>3.</td>
<td>RCC band at plinth level</td>
<td>M-20 RCC 200 mm thick</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Super structure masonry</td>
<td>RR stone/brick masonry in cement sand mortar 1:6</td>
<td>Brick masonry may be preferred where good quality of stone is not available.</td>
</tr>
<tr>
<td>5.</td>
<td>Lintel Sunshades</td>
<td>RCC lintel/Chajjas in M-20 Grade CC (1:1.5:3).</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Roofing</td>
<td>RCC roofing in CC M-20 Grade CC (1:1.5:3).</td>
<td></td>
</tr>
<tr>
<td><strong>7. FLOORING/SKIRTING:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Rooms, Passages etc.</td>
<td>Vitrified tiles and green marble on steps.</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Toilet floor/Dado</td>
<td>Ceramic, Glazed and mat finish tiles.</td>
<td>Up to Lintel level.</td>
</tr>
<tr>
<td>(c)</td>
<td>Approach path/Pavement</td>
<td>150mm thick CC floor M-30 grade with base concrete 1:4:8, 150 mm thick sub base, 200 MM thick stone soling /quarry rubbish.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Window sill</td>
<td>Green marble with double rounded edge.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Almirah shelf</td>
<td>Polished Kota stone shelves.</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Coping</td>
<td>Precast cement concrete coping M-15 grade (1:2:4) 50mm thick.</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Plinth protection</td>
<td>Anti-skid heavy duty vitrified tiles under porch &amp; chequered tile for plinth protection 1.20 M wide all around for 220 KV control room</td>
<td></td>
</tr>
<tr>
<td><strong>14. FINISHING WORK:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Plaster on walls</td>
<td>20 mm thick plaster in cement sand mortar 1:6 with P.O.P.</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Exterior finish</td>
<td>Weather proof paint with base of Birla/JK or equivalent putty.</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>Interior surface finish</td>
<td>Plastic paint in 220 KV C.R. with P.O.P.</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>Doors and windows</td>
<td>All steel &amp; wooden doors and windows to be enamel painted with primer.</td>
<td></td>
</tr>
<tr>
<td><strong>15. WOOD WORK:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Door shutter</td>
<td>Flush door 30mm thick with</td>
<td></td>
</tr>
</tbody>
</table>
commercial ply on both in Admin. Block and in C.R. hall entry, main entry near porch and exit door of shall be of aluminum as per design. Along with battery and PLCC room.

| (b) | Curtains | Curtains & curtain rod for rest room, dining room & offices in 220 KV Control Room. | Aluminum rods with fancy Brackets are also permitted on approval. |
| (c) | Almirah | CRC sheets 20 SWG shutters with locking arrangement | Almirah shutters be provided upto lintel level only. |

### 16. WINDOW & VENTILATOR

| (a) | Windows | Aluminum window with toughened glass panes as per design in 220 kv control room, Adm block, Restroom, security room. Steel section window as per appd. design with plain/pin headed glass panes in sore shed | Pin headed glass panes to be used in rest room and toilets. Aluminum wire mesh shall be provided at exterior face. |
| (b) | Door Frame | T-Section/EZ-7 | - |
| (c) | Stair case head room door shutters | MS Sheet 20 SWG shutters with angle iron frame. | - |
| (d) | Stair case railing | S.S. railing for stair case | S.S. railing for 220 KV Control Room stair case. |

### 17. Roof Treatment

| | Mosaic tile terracing with grading concrete of CC 1:3:6 | CC grading to be provided below tiles as per actual requirement for proper drainage of water. |

### 18. Rain water piles (down take)

| | PVC pipe | Rain water down take pipe be provided. |

### 19. False Ceiling

| | Calcium Silicate Board false ceiling in Control Room hall, PLCC, Battery Room, Incharge Room & Rest Rooms | - |

### B- SANITARY WORK:

1. **W.C.**
   - (i) For general toilet orrisa pan.
   - (ii) For toilets with office chamber: EWC.
   - (iii) For rest room: Two piece EWC i.e. cascade type models in Oval, rectangle shapes to be used with PVC cistern of approved make.

2. **Wash Basin in general and attached.**
   - With vitreous China of suitable size as per drawing.
   - Bottle traps in rest room and office chambers be used.

3. **Mirror**
   - Mirror with beveled edge suitable size.

4. **Bib cocks and stop cocks.**
   - C.P. Brass bib cocks and stop cocks.

5. **Pipe lines.**
   - G.I. pipe “B” class as per approved specification/size

6. **Sewer pipes**
   - 100mm dia ISI approved S.W. pipes/ Rigid PVC Pipe
   - For internal pipe network for disposed PVC
<table>
<thead>
<tr>
<th></th>
<th>Water Tank</th>
<th>PVC water tank as per approved drawing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Main Hole Covers</td>
<td>Ferrow cement concrete cover.</td>
<td></td>
</tr>
<tr>
<td><strong>C. ELECTRIC WORK:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Wiring work</td>
<td>PVC insulated wiring in PVC recessed conduit with copper conductor</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Light fixtures &amp; accessories.</td>
<td>As per approved design &amp; drawing. Ceiling fans shall be provided in control room building, rest rooms, dining hall, kitchen, dormitory, security hut.</td>
<td>(i) All accessories &amp; fixtures shall be of category-I with Modular Switches. Fans to be provided in 220 KV Control Room.</td>
</tr>
<tr>
<td>3</td>
<td>Earthing</td>
<td>Earthing with G.I. earth plate 600 x 600 x 6 mm as per IS 3043.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MCB &amp; distribution Board</td>
<td>MCB &amp; isolators of suitable rating with steel sheet distribution board.</td>
<td></td>
</tr>
</tbody>
</table>
## SPECIFICATION (MAKE) OF VARIOUS BUILDING MATERIALS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEM</th>
<th>Specification as per BSR/Guideline</th>
<th>APPROVED MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teak Ply commercial Ply/ Shuttering (Water proof ply)</td>
<td>IS -1328, 303 &amp; 4898</td>
<td>Kit ply/National Duroply/Century</td>
</tr>
<tr>
<td>2</td>
<td>Particle Board/Block Board</td>
<td>-</td>
<td>Kit ply/Bhutan Board Nova Pan/ Duro Board.</td>
</tr>
<tr>
<td>3</td>
<td>Die cast steel fittings for door &amp; windows</td>
<td>-</td>
<td>Chandak/tripe</td>
</tr>
<tr>
<td>4</td>
<td>Aluminum fittings</td>
<td>-</td>
<td>Vayudut/Paul Swastick/spider</td>
</tr>
<tr>
<td>5</td>
<td>Glass Panes</td>
<td>-</td>
<td>Modiguard/Atul/Admiral.</td>
</tr>
<tr>
<td>6</td>
<td>Steel rolled section for steel windows. Vent &amp; EZ-7 section for door frames</td>
<td>I.S. 7452</td>
<td>Prithvi/Mahabir/Perry/Grover/ Shiv Ganesh/NAV.</td>
</tr>
<tr>
<td>7</td>
<td>Steel rolled section like square Bar Flat. Angle tee etc. for gate, grill railing etc.</td>
<td>-</td>
<td>Prithvi/ Natani/ Capital.</td>
</tr>
<tr>
<td>8</td>
<td>M.S. Pipe for gate/railing</td>
<td>-</td>
<td>Jindal/Oswal</td>
</tr>
<tr>
<td>9</td>
<td>Tor steel</td>
<td>IS-1786</td>
<td>TISCO/SAIL/RINL</td>
</tr>
<tr>
<td>10</td>
<td>M.S. Sheet for steel doors etc.</td>
<td>-</td>
<td>Jindal/Sail/Nippon</td>
</tr>
<tr>
<td>11</td>
<td>C.G.I. Sheets</td>
<td>-</td>
<td>SAIL/TATA/JINDAL</td>
</tr>
<tr>
<td>12</td>
<td>A.C. Sheets</td>
<td>-</td>
<td>Charminar/ Everest/ Lotus</td>
</tr>
<tr>
<td>13</td>
<td>Wire Gauge</td>
<td>-</td>
<td>VIKAS / PRATEEK LAXMI</td>
</tr>
<tr>
<td>14</td>
<td>Terrazzo tiles for floor &amp; roof terracing</td>
<td>-</td>
<td>K.G. tile/NITCO/ Jain/ Mayur/ S.E. Tiles (Sharda)/ A.K. Tiles.</td>
</tr>
<tr>
<td>15</td>
<td>P.V.C. flooring</td>
<td>IS - 3461</td>
<td>Bhor (Marbilex)</td>
</tr>
<tr>
<td>16</td>
<td>P.V.C. flooring FLEXIBLE</td>
<td>Is – 3462</td>
<td>Royal/Birla</td>
</tr>
<tr>
<td>17</td>
<td>Enamel paint</td>
<td>-</td>
<td>Asian (approlite) Nerolac/ Berger. (LUXOL)/ ICI (DULUX).</td>
</tr>
<tr>
<td>18</td>
<td>Oil Ground Distemper</td>
<td>-</td>
<td>Asian (Tractor) Nerolac/ Berger</td>
</tr>
<tr>
<td>19</td>
<td>Aluminum Paint</td>
<td>-</td>
<td>Nerolac/Asian</td>
</tr>
<tr>
<td>20</td>
<td>Water proof cement paint</td>
<td>-</td>
<td>Snowcem Plus</td>
</tr>
<tr>
<td>21</td>
<td>Floor Polish</td>
<td>-</td>
<td>Mansion</td>
</tr>
<tr>
<td>22</td>
<td>Stainer (Placement) mixed for colour wash</td>
<td>-</td>
<td>Asian (Abcolite)</td>
</tr>
</tbody>
</table>

Only in respect of tiles containing marble toping of mixed colour chips subject meeting the strength & other tests requirement as per BIS.
### SPECIFICATION (MAKE) OF VARIOUS ITEMS ACCESSORIES FOR WATER SUPPLY AND SANITARY FITTINGS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>ITEM</th>
<th>Specification as per BSR/ Guideline</th>
<th>APPROVED MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G.I. Pipe</td>
<td>I.S. -1239</td>
<td>T.T. Swastick/ Jindal/ Prakash Surya</td>
</tr>
<tr>
<td>2</td>
<td>G.I. Fittings (Tee/ Elbow / Socket etc.)</td>
<td>-do-</td>
<td>NMC/555/ZEN/ UNIK/UCO/L&amp;K/SEIKO</td>
</tr>
<tr>
<td>3</td>
<td>A.C. Pipe</td>
<td>I.S. -1626</td>
<td>Himalaya/Atlas/Shri/Amar</td>
</tr>
<tr>
<td>4</td>
<td>S.C.I. Pipe &amp; Fittings</td>
<td>I.S. -1729</td>
<td>Jindal/A-one/SECO/ABC/Bajaj/ HIF/RIF/NECO</td>
</tr>
<tr>
<td>5</td>
<td>P.V.C. Pipe &amp; Fittings.</td>
<td>I.S. -4985</td>
<td>Supreme Prince/Finolex Kisan</td>
</tr>
<tr>
<td>6</td>
<td>S.W. Pipe &amp; Fittings</td>
<td>I.S. -651</td>
<td>Perfect Pottery/ MCI/RK/Tata</td>
</tr>
<tr>
<td>7</td>
<td>W.C. Pan</td>
<td>I.S. -2556</td>
<td>Hindustan/ Parryware/Cera</td>
</tr>
<tr>
<td>8</td>
<td>Wash Basin</td>
<td>I.S. -2556</td>
<td>Hindustan/ Parry ware/Cera</td>
</tr>
<tr>
<td>9</td>
<td>Urinal</td>
<td>I.S. -2550</td>
<td>-do-</td>
</tr>
<tr>
<td>10</td>
<td>Sink</td>
<td>I.S. -2556</td>
<td>-do-</td>
</tr>
<tr>
<td>11</td>
<td>Seat cover</td>
<td>I.S. -2548</td>
<td>Rainbow / Agrawal/ Kukoo/ Supreme/ Kisan</td>
</tr>
<tr>
<td>12</td>
<td>Flush cock</td>
<td>I.S. -9758</td>
<td>Kingston/ L&amp;K/ Plumber / JVC/ Elco.</td>
</tr>
<tr>
<td>13</td>
<td>Mirror</td>
<td>-</td>
<td>Atul / Modiguard.</td>
</tr>
<tr>
<td>14</td>
<td>C.P. Fittings</td>
<td>IS- 8937 &amp; 8934 (Pillar)</td>
<td>Kingston/ Jal/ Orient/ Plumber</td>
</tr>
<tr>
<td>15</td>
<td>Brass bib cock/stop cock</td>
<td>I.S. -8931</td>
<td>Kiran/L&amp;K/Plumber/KMJ/ (Krishna/Neta/ Parko</td>
</tr>
<tr>
<td>16</td>
<td>Ceramic floor tiles</td>
<td>-</td>
<td>Spartek/Kajaria/Somani/ JOHNSON</td>
</tr>
<tr>
<td>17</td>
<td>Glazed tile</td>
<td>I.S. -771</td>
<td>Kajaria/Somani/ JOHNSON</td>
</tr>
<tr>
<td>18</td>
<td>Ball cock</td>
<td>I.S. -1703</td>
<td>CICO/Sonex/ Plumber/L&amp;K</td>
</tr>
<tr>
<td>19</td>
<td>Full way Valve</td>
<td>I.S. -778</td>
<td>Leader/Guide NMW/ WIN/UTAM</td>
</tr>
<tr>
<td>20</td>
<td>PVC storage tank</td>
<td>I.S. -12701</td>
<td>Sintex/Polycom</td>
</tr>
<tr>
<td>21</td>
<td>PVC flushing Cistern</td>
<td>-</td>
<td>Hindustan/Parryware/ Cera/ Kisan</td>
</tr>
<tr>
<td>22</td>
<td>C/ Manhole cover</td>
<td>-</td>
<td>SPLU/KMJ/Bajaj</td>
</tr>
<tr>
<td>23</td>
<td>Tonal Roil/ Ring other accessories</td>
<td>-</td>
<td>Kingston/Metro/NEBCO/Somani/ARK</td>
</tr>
<tr>
<td>S.No.</td>
<td>Item</td>
<td>Specification as per BSR/Guideline</td>
<td>Approved make</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------</td>
<td>------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Hinges</td>
<td>I.S. -205</td>
<td>Raja/Shiva/Priya/Puja</td>
</tr>
<tr>
<td>2</td>
<td>Handle (C.P. Steel)</td>
<td>I.S. -208</td>
<td>Shiva/Priya/Chand</td>
</tr>
<tr>
<td>3</td>
<td>Aldrop/ Sliding bolt (C.P. Steel)</td>
<td>I.S. -268</td>
<td>Shiva/Priya/Prince/Chandak</td>
</tr>
<tr>
<td>4</td>
<td>Tower bolt</td>
<td>I.S. -204</td>
<td>Shiva/Priya/Chand/CIC</td>
</tr>
<tr>
<td>5</td>
<td>Door stopper (C.P. Steel 2 Legged)</td>
<td>-</td>
<td>Shiva/Chandak</td>
</tr>
<tr>
<td>6</td>
<td>Hydraulic door closure</td>
<td>I.S. -3564</td>
<td>Everite/Empire/Prabhat/Sandhu/Amar.</td>
</tr>
<tr>
<td>7</td>
<td>Almirah lock</td>
<td>-</td>
<td>Godrej/Senchurie/Jainson.</td>
</tr>
<tr>
<td>8</td>
<td>Floor spring</td>
<td>-</td>
<td>Everite/Empire/Sandhu/Amar.</td>
</tr>
<tr>
<td>9</td>
<td>Aluminium Section</td>
<td>-</td>
<td>Hindalco/Jindal/Mahaveer</td>
</tr>
<tr>
<td>10</td>
<td>Brass Handles steel Windows</td>
<td>-</td>
<td>Flora/Shilpi/Kohinoor</td>
</tr>
<tr>
<td>11</td>
<td>Door spring</td>
<td>-</td>
<td>A-one/YEN</td>
</tr>
</tbody>
</table>
**ANNEXURE-9**

SPECIFICATION (MAKE) OF VARIOUS ITEMS ACCESSORIES FOR ELECTRICAL FITTINGS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
<th>As per BSR/Guideline</th>
<th>Proposed make as per quality available</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PVC insulted aluminium conductor cable</td>
<td>IS -694 Cat/II</td>
<td>Havells, Rallison Plaza/ Romax</td>
</tr>
<tr>
<td>2.</td>
<td>PVC insulted copper conductor cable</td>
<td>I.S. -694 Cat/II</td>
<td>Ecko, Havells, Plaza Tambi, Rallison, Polycab</td>
</tr>
<tr>
<td>3.</td>
<td>PVC conduit (2 mm thick)</td>
<td>OSWAL/SETIA/AKG/ A-One Plast/ BEC /Plaza</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Steel conduit pipe laid on surface/ recessed</td>
<td>16 SWG</td>
<td>A.M.I./Vidyut, BEC</td>
</tr>
<tr>
<td>5.</td>
<td>Fan Box</td>
<td></td>
<td>Vidyut or other local without any brand names.</td>
</tr>
<tr>
<td>6.</td>
<td>Flush type switches &amp; other accessories</td>
<td>Cat. II</td>
<td>SSK/SK/555/Anchor</td>
</tr>
<tr>
<td>7.</td>
<td>Sumica sheet with Bakelite base (3mm)</td>
<td>Cat. I &amp; II</td>
<td>Formica/Hylam</td>
</tr>
<tr>
<td>8.</td>
<td>Brass/ Bakelite holders</td>
<td>Cat. II</td>
<td>Khosla/Antex</td>
</tr>
<tr>
<td>9.</td>
<td>Metal clad fuse unit with reviceable fuses</td>
<td>Cat. II</td>
<td>GEC/Crompton/SSK/Milborn</td>
</tr>
<tr>
<td>10.</td>
<td>MCB &amp; DB Unit</td>
<td>Cat. II</td>
<td>Bentex/Datar/Clariton</td>
</tr>
<tr>
<td>11.</td>
<td>Kit Kat fuse</td>
<td>Cat. II</td>
<td>Standard, Crompton, Kinbar/GEC</td>
</tr>
<tr>
<td>12.</td>
<td>Bilk head fittings</td>
<td>Cat. II</td>
<td>Bajaj/Glolite/ Crompton</td>
</tr>
<tr>
<td>13.</td>
<td>Tubes light fixture with all accessories line choke, starter &amp; tube rod.</td>
<td>Cat. I</td>
<td>Crompton/ Baja</td>
</tr>
<tr>
<td>14.</td>
<td>Exhaust Fan</td>
<td>IS-2312 Cat. II</td>
<td>Bajaj/ Crompton</td>
</tr>
<tr>
<td>15.</td>
<td>Fresh Air Fan</td>
<td>Cat. II</td>
<td>Bajaj/ Crompton/ Khetan</td>
</tr>
<tr>
<td>16.</td>
<td>Electronic Regulator</td>
<td>Cat. I</td>
<td>Rider/ Anchor</td>
</tr>
<tr>
<td>17.</td>
<td>Industrial socket</td>
<td></td>
<td>Cutler Hamma/Crompton/ Indo-Kupp</td>
</tr>
<tr>
<td>18.</td>
<td>Ceiling Rose</td>
<td></td>
<td>SSK/Veto/Anchor</td>
</tr>
<tr>
<td>19.</td>
<td>Call Bell</td>
<td>IS - 2268</td>
<td>Leader/ Anchor</td>
</tr>
</tbody>
</table>

**ANNEXURE-10**

ACCEPTING AND DEVIATION DISPOSITIONING AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLAN AS WELL AS DEVIATION IN QUANTITY

<table>
<thead>
<tr>
<th>Category</th>
<th>Type of Check</th>
<th>100% Checking/witnessing by</th>
<th>Counter check/surveillance check by</th>
<th>Accepting authority, if Test Results are within permissible limits</th>
<th>Deviation Dispositioning Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>'A'</td>
<td>Critical</td>
<td>Site Engineer</td>
<td>Engineer nominated by Director-Tech.</td>
<td>Site Engineer</td>
<td>Director-Tech</td>
</tr>
<tr>
<td>'B'</td>
<td>Major</td>
<td>Site Engineer</td>
<td>Engineer nominated by Director-Tech</td>
<td>Site Engineer</td>
<td>Director-Tech</td>
</tr>
<tr>
<td>'C'</td>
<td>Minor</td>
<td>Site Engineer</td>
<td>Engineer nominated by Director-Tech</td>
<td>Site Engineer</td>
<td>Director-Tech</td>
</tr>
</tbody>
</table>
## ANNEXURE-11

**ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS & CONCRETE:**

### (A) CEMENT:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of the tests</th>
<th>33 grade OPC as per IS:269</th>
<th>43 grade cement as per IS: 8112</th>
<th>PPC as per IS: 1489</th>
<th>Low heat cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Fineness (Min.)</td>
<td>225 m$^2$/kg</td>
<td>225 m$^2$/kg</td>
<td>300 m$^2$/kg</td>
<td>225 m$^2$/kg</td>
</tr>
<tr>
<td>ii)</td>
<td>Compressive Strength (Min.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>72 ± 1 hours</td>
<td>160 kgf/cm$^2$</td>
<td>23 MPa</td>
<td>16 MPa</td>
<td>100 kgf/ CM$^2$</td>
</tr>
<tr>
<td></td>
<td>168 ± 2 hours</td>
<td>220 kgf/cm$^2$</td>
<td>33 MPa</td>
<td>22 MPa</td>
<td>160 kgf/cm$^2$</td>
</tr>
<tr>
<td></td>
<td>672 ± 4 hours</td>
<td>-</td>
<td>43 MPa</td>
<td>33 MPa</td>
<td>350 kgf/cm$^2$</td>
</tr>
<tr>
<td>iii)</td>
<td>Initial Setting Time (Minimum)</td>
<td>30 Minutes</td>
<td>30 Minutes</td>
<td>30 Minutes</td>
<td>30 Minutes</td>
</tr>
<tr>
<td>iv)</td>
<td>Final Setting Time (maximum)</td>
<td>600 Minutes</td>
<td>600 Minutes</td>
<td>600 Minutes</td>
<td>600 Minutes</td>
</tr>
<tr>
<td>v)</td>
<td>Soundness (Le chatelier Method)</td>
<td>Max. 10mm expansion</td>
<td>Max. 10mm expansion</td>
<td>Max. 10mm expansion</td>
<td>Max. 10 mm expansion</td>
</tr>
<tr>
<td>vi)</td>
<td>Heat of hydration (Max.)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Max. 65 cal/ gm for 7 days &amp; max. 75 cal/ gm for 28 days</td>
</tr>
<tr>
<td>vii)</td>
<td>Chemical Composition</td>
<td>As per IS</td>
<td>As per IS</td>
<td>As per IS</td>
<td>As per IS</td>
</tr>
</tbody>
</table>

### (B) COURSE AGGREGATE:

(i) Sieve Analysis:

<table>
<thead>
<tr>
<th>Is sieve designation</th>
<th>Percentage passing for graded Aggregate of Nominal Size</th>
<th>Percentage passing for single sized aggregate of Nominal size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40mm</td>
<td>20mm</td>
</tr>
<tr>
<td>63 mm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>40 mm</td>
<td>95 to 100</td>
<td>100</td>
</tr>
<tr>
<td>20 mm</td>
<td>30 to 70</td>
<td>95 to 100</td>
</tr>
<tr>
<td>10 mm</td>
<td>10 to 35</td>
<td>25 to 55</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>0 to 5</td>
<td>0 to 10</td>
</tr>
</tbody>
</table>

(ii) Flakiness Index: Not to exceed 25%

(iii) Crushing Value: Not to exceed 45%

(iv) Soundness of aggregate applicable for concrete works subject to frost action: Loss of weight after 5 cycle not to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate.

(v) Deleterious material: Not to exceed 5% of the weight of aggregate when tested as per IS: 2386 Part-II (1963)

### (C) FINE AGGREGATE

(i) Sieve Analysis shall confirm to Zone 1, Zone II or Zone III.
(ii) For guidance of adjusting sound in mix of concrete, the following table may be used.

<table>
<thead>
<tr>
<th>IS sieve designation</th>
<th>Percentage Passing for</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grading Zone-I</td>
</tr>
<tr>
<td>10 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>60-95</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>30-70</td>
</tr>
<tr>
<td>600 Micron</td>
<td>15-34</td>
</tr>
<tr>
<td>300 Micron</td>
<td>15-20</td>
</tr>
<tr>
<td>150 Micron</td>
<td>0-10</td>
</tr>
</tbody>
</table>

(iii) Silt Content Test: shall not exceed 8% by volume when tested as per test procedure specified in appendix-D of chapter 3 of 1991-92 CPWD specification.

(iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for 1:1 ½ :3 (cement : Sand: Coarse aggregate) concrete shall be 265 kg/cm² for 28 days and for 1:2:4 nominal mix. It shall be 210 mg/cm².

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength up to 30% than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-charge.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of Bidder. If, however, the Engineer-in-Charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the Bidder.
(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS: 456-2000

(H) SAMPLING PLAN FOR BRICK - WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

<table>
<thead>
<tr>
<th>No. of bricks in the lot</th>
<th>For characteristics specified for individual bricks</th>
<th>For dimensional characteristics for group of 20 bricks No. of bricks to be selected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of bricks to be selected</td>
<td>Permissible No. of defective in the sample</td>
</tr>
<tr>
<td>2001-10000</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>10001-35000</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>35001-50000</td>
<td>50</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

Scale of sampling for physical characteristics

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Sampling size for compressive strength water absorption and efflorescence</th>
<th>Permissible No. of defectives for efflorescence</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001-10000</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>10001-35000</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>35001-50000</td>
<td>15</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

(I) ACCEPTANCE CRITERIA FOR BRICK-WORK

(i) Dimensional tolerances: The dimensions of modular bricks when tested shall be within the following limits per 20 bricks:

Length 372 to 388 cm (380 ± 8 cm).
Width 176 to 184 cm (180 ± cm).
Height 176 to 184 cm (180 ± 4 cm) for 90 mm high bricks.

(ii) In case of non-modular bricks, % age tolerance will be ± 2% for group of 20 numbers of class-10 bricks, and ± 4% for other class of bricks.

(iii) Compressive strength: The bricks, shall have a minimum average compressive strength as specified in the specification. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified for the purpose of calculating the average compressive strength.

(iv) Water absorption: The average water absorption of bricks shall not be more than 20% by weight.

(v) Efflorescence: The rating of efflorescence of bricks shall not be more than moderate.
### TENTATIVE QUANTUM OF CIVIL WORKS TO BE EXECUTED FOR CONSTRUCTION OF 220 KV PPS-1, 2, 3 & 4 AT NOKH SOLAR PARK

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty. for PPS-I (Apprx.)</th>
<th>Qty. for PPS -II (Apprx.)</th>
<th>Qty. for PPS -III (Apprx.)</th>
<th>Qty. for PPS-IV (Apprx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Geotechnical Investigation including soil testing as per specification</td>
<td>LOT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Site preparation including cutting, filling of earth and leveling, dressing of complete substation area as per the contour maps, enclosed with volume-III</td>
<td>LOT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>Grading and gravelling of switchyard area as marked in Electrical Layout plan, enclosed with volume-III</td>
<td>Sq. Mtr.</td>
<td>17200</td>
<td>12700</td>
<td>12700</td>
<td>17200</td>
</tr>
<tr>
<td>4.</td>
<td>Drainage system of Control room, Dormitory, switchyard and approach yard including rain water harvesting system as per specification.</td>
<td>LOT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Construction of A class 3.00mtr wide road including culvert Roads &amp; Culverts :</td>
<td>R.M.</td>
<td>320.00</td>
<td>320.00</td>
<td>320.00</td>
<td>320.00</td>
</tr>
<tr>
<td>(I)</td>
<td>3 meter wide road with shoulder &amp; kerb stone on both side</td>
<td>R.M.</td>
<td>200.00</td>
<td>300.00</td>
<td>300.00</td>
<td>200.00</td>
</tr>
<tr>
<td>(II)</td>
<td>3 mtr. wide road without shoulder &amp; without kerb stone</td>
<td>R.M.</td>
<td>600.00</td>
<td>570.00</td>
<td>570.00</td>
<td>600.00</td>
</tr>
<tr>
<td>6.</td>
<td>Construction of AA class 4.00 mtr wide road including culvert with shoulder &amp; kerb stone on both side</td>
<td>R.M.</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>7.</td>
<td>Construction of foundation of AT1/AT3 Structure</td>
<td>Nos.</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>8.</td>
<td>Construction of foundation of AT4 Structure</td>
<td>Nos.</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>10.</td>
<td>Construction of foundation of AO1 Structure</td>
<td>SET</td>
<td>23</td>
<td>26</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>11.</td>
<td>Construction of foundation of AO1(T) Structure</td>
<td>SET</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>12.</td>
<td>Construction of foundation of AO3 Structure</td>
<td>Nos.</td>
<td>33</td>
<td>39</td>
<td>39</td>
<td>33</td>
</tr>
<tr>
<td>13.</td>
<td>Construction of foundation of AO4 Structure</td>
<td>Nos.</td>
<td>18</td>
<td>24</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>14.</td>
<td>Construction of foundation of AO5 Structure</td>
<td>Nos.</td>
<td>18</td>
<td>21</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>15.</td>
<td>Construction of foundation of PIS type Structure</td>
<td>LOT</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>16.</td>
<td>Construction of foundation of X-15(for 33 kv Isolator) Structure</td>
<td>Nos.</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>52</td>
</tr>
<tr>
<td>17.</td>
<td>Construction of foundation of 33 kv CT/PT Structure</td>
<td>Nos.</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Nos.</td>
<td>Lot</td>
<td>LOT</td>
<td>LOT</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
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<td>18</td>
<td>Construction of foundation of XYZ Structure</td>
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<td>Construction of foundation of XY/Y Structure</td>
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<td>Construction of foundation of 220 KV Breaker</td>
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<td>Construction of foundation of 33 KV Breaker</td>
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<td>22</td>
<td>Construction of foundation with gravel/boulder filling including civil work for oil collection in oil pit for 220/33kv,100MVA Transformer</td>
<td>Nos.</td>
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<td>Construction of foundation with gravel/boulder filling including civil work for oil collection in oil pit for 220/33kv,25MVAR, BUS Reactor</td>
<td>Nos.</td>
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<td>24</td>
<td>Civil works for oil collection in oil pit of 10000 litres capacity required for firefighting system in respect of 220/33 kv,100 MVA Transformer</td>
<td>Nos.</td>
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<td>25</td>
<td>Construction of foundation of 33/0.4, 250 KVA Station Transformer</td>
<td>Nos.</td>
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<td>Construction of foundation of 11/0.4, 100 KVA Station Transformer</td>
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<td>27</td>
<td>Construction of type-Ax cable trenches including Ferro cement cover</td>
<td>R.M.</td>
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<td>28</td>
<td>Construction of type-A cable trenches including Ferro cement cover</td>
<td>R.M.</td>
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<td>29</td>
<td>Construction of type-C cable trenches including Ferro cement cover</td>
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<td>30</td>
<td>Construction of type-D cable trenches including Ferro cement cover</td>
<td>R.M.</td>
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<td>31</td>
<td>Providing/laying PVC pipe Type B-150 mm dia with accessories(for road crossing)</td>
<td>R.M.</td>
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<td>32</td>
<td>Construction of Control room building &amp; rest rooms complete in all respect as per specification including cable trenches and 6mm, thick chequered plate covers inside control room, PLCC, Battery room &amp; sanitary, electrical fittings etc. including illumination of control room, rest rooms as per specification Vol-III.</td>
<td>LOT</td>
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<td>33</td>
<td>Supply, Installation and testing of 5 star rating split inverter A.C.(make approved by RSDCL) in control room, incharge room, rest room as per approved design and standard unit including all required electrification works/items as per specification</td>
<td>Nos.</td>
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<td>(i)</td>
<td>2.0 Ton capacity with inverter A.C. indoor type, 5 star rated (with stabilizer 05 kva)</td>
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<td>(ii)</td>
<td>1.50 Ton capacity with inverter A.C. indoor type, 5 star rated (with stabilizer 05 kva)</td>
<td>Nos.</td>
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<td>34.</td>
<td>Furnishing of control room as per specification &amp; Annexure-</td>
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<td>35.</td>
<td>Furnishing of Rest rooms &amp; Dining room as per specification &amp; Annexure-</td>
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<td>36.</td>
<td>Water cooler (40 litres) of Voltas/Blue star as per specification &amp; Annexure with Vol-III (with R.O. with sufficient capacity &amp; reputed make)</td>
<td>SET</td>
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<td>37.</td>
<td>Construction of Chain link fencing with toe wall as per approved drawing for switchyard as per specification clause No.13.0, Vol-III</td>
<td>R.M.</td>
<td>120</td>
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<td>38.</td>
<td>P &amp; F M.S. PPS Main Gate with wicket Gate, pillars, cattle catcher for entry to PPS premises as per specification</td>
<td>Nos.</td>
<td>1</td>
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<td>39.</td>
<td>P &amp; F M.S. Switch yard Gate with pillars for entry to switchyard as per specification</td>
<td>Nos.</td>
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<td>40.</td>
<td>Construction of Pucca Parking Area for six Nos. cars with RCC Roofing &amp; pavement as per specification</td>
<td>Sq.m</td>
<td>75.00</td>
<td>75.00</td>
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<td>41.</td>
<td>Construction of Store shed as per approved drawing</td>
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<td>1</td>
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<td>42.</td>
<td>Construction of Boundary wall of PPS premises with railing, barbed wire, Y-Shape angle as per specification</td>
<td>R.M.</td>
<td>800.00</td>
<td>800.00</td>
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<td>43.</td>
<td>Under ground water storage tank size 5.0m x 3.0m x 2.0m with submercible electric motor of 2 HP capacity with switch board, starter to be placed in pump room to cater water supply for main water supply system and water pipe line to control room, rest rooms, dormitory, security hut and transformer yard as per specification.</td>
<td>LOT</td>
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<td>1</td>
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<td>44.</td>
<td>Park/Loan of 30 m x 12 m size with 0.60 m high boundary wall, 0.60 M.S. Ralling and entrance gate in front of control room/porch.</td>
<td>LOT</td>
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<td>45.</td>
<td>Construction of Security / Guard Hut at Main Gate of PPS as per specification</td>
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<td>46.</td>
<td>Providing/Fixing of Glow sign board at roof of Control room building</td>
<td>Nos.</td>
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<td>1</td>
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<td>47.</td>
<td>Providing/Fixing of Glow sign board at Ground near the entrance gate of PPS</td>
<td>Nos.</td>
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<td>48.</td>
<td>Construction of Meter shed of size 4.0 m x 3.0 m x 2.5 m with GI sheet roofing.</td>
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<td>49.</td>
<td>Construction of Dormitory building with all sanitary, electrical, doors, window fittings in all respect as per specification, Vol-III</td>
<td>LOT</td>
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<td>50.</td>
<td>Furnishing of Dormitory building as per specification &amp; Annexure-</td>
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<td>51</td>
<td>Providing/Fixing of Interlocking block in PPS premises near the control room &amp; dormitory as per specification</td>
<td>Sq. Mtr.</td>
<td>600</td>
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Note: The above said quantity is tentative & may vary to any extent as per site requirement.
### Section: FOUNDATION MATERIALS

<table>
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<th>S. No.</th>
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<tr>
<td>1.</td>
<td>CHECKING OF FOUNDATION MATERIALS</td>
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<td>A</td>
<td>CEMENT</td>
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<td>i)</td>
<td>Fineness</td>
<td>One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing</td>
<td>IS:456, IS:269, IS: 8112, IS: 12269, IS: 1489 &amp; RSDCL specification</td>
<td>Manufacturer/ RVPN approved lab</td>
<td>Review of manufactures test certificates (MTCs) and laboratory test results by RSDCL</td>
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<td>ii)</td>
<td>Compressive Strength</td>
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<td>iii)</td>
<td>Initial &amp; final setting time</td>
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<td>iv)</td>
<td>Soundness</td>
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<td>v)</td>
<td>Heat of Hydration for low heat cement (Not applicable for OPC &amp; PPC)</td>
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<td>vi)</td>
<td>Chemical Composition of Cement</td>
<td>One sample per lot of 100 MT or part thereof from each source for MTCs</td>
<td>IS: 456, IS: 269, IS: 8112, IS: 12269, IS: 1489 &amp; RSDCL specification</td>
<td>Manufacturer</td>
<td>Review of manufacturers test certificates by RSDCL</td>
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<td>COARSE AGGREGATES</td>
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<td>i)</td>
<td>Determination of Particle size (Sieve Analysis)</td>
<td>One sample per lot of 100 cubic meter or part thereof from each source for each size</td>
<td>IS: 383, IS: 2386 &amp; RSDCL specification</td>
<td>RVPN approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site</td>
<td>Each source to be approved by RVPN Review and acceptance of test result by RSDCL</td>
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<td>ii)</td>
<td>Flakines index</td>
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<td>iii)</td>
<td>Crushing Value</td>
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<td>Specific Gravity*</td>
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<td>Bulk Density*</td>
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<td>Absorption Value*</td>
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<td>Moisture Content*</td>
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<td>viii)</td>
<td>Soundness of Aggregate**</td>
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<td>ix)</td>
<td>Presence of deleterious materials</td>
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*Applicable Design concretes only
** Applicable to concrete work subject to frost action
### Section: FOUNDATION MATERIALS

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<td>i) Gradation/ Determination of Particle size (Sieve Analysis)</td>
<td>One sample per lot of 100 cubic meter or part thereof from each source</td>
<td>IS: 383, IS: 2386, IS: 456 and RSDCL specification</td>
<td>RVPN approved lab. However Moisture content test for design mix concrete shall be done on all days of concreting at site</td>
<td>Each source to be approved by RSDCL Review and acceptance of test result by RSDCL</td>
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<td>ii) Specific Gravity and density *</td>
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<td>iv) Absorpotion Value*</td>
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<td>v) Bulking</td>
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<td>vi) Silt Content Test</td>
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<td>vii) Presence of deleterious materials</td>
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<td>i) Dimensional tolerance</td>
<td>As per enclosed Annexure-II</td>
<td>PWD &amp; RSDCL specification</td>
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<td>ii) Compressible Strength</td>
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<td>iii) Water Absorption</td>
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<td>iv) Efflorescence</td>
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<td>WATER</td>
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<td>i) Cleanliness (Visual Check)</td>
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<td>IS: 456, IS: 3025 and RSDCL specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalies, organic materials, or other deleterious materials</td>
<td>Bidder</td>
<td>Each source to be approved by RSDCL</td>
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<td>ii) Chemical and physical properties of water for checking its suitability for construction purposes</td>
<td>One sample per source</td>
<td>IS: 456, IS: 3025 and RSDCL specification</td>
<td>Bidder/ RVPN Approved Lab</td>
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* Applicable to design mix concretes only.
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<th>REINFORCEMENT STEEL</th>
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<td>i) Identification &amp; size</td>
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<td>ii) Chemical Analysis test</td>
<td>One sample per heat</td>
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<td>iii) Tensile Test</td>
<td>One sample per lot of 40 MT or part thereof for each size of steel conforming to IS: 1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS: 432. For steel as per IS: 1786 under 10 mm 1 sample for each 25 MT or part thereof. 20 mm 16 mm 1 sample for each 35 MT or part thereof. Over 16 mm 1 sample for each 45 MT or part thereof.</td>
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<td>iv) Yield stress/ proof stress</td>
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<td>v) Percentage Elongation</td>
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### Section: Foundation Materials

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<tr>
<td>vi)</td>
<td>Bend/ Rebend Test</td>
<td>One sample per lot of 20 MT or part thereof for each size of steel as per IS: 432, IS: 1139. For steel as per IS: 1786 under 10 mm-16mm 1 sample for each 25 MT or part thereof 10 mm-16mm 1 sample for each 45 MT or part thereof</td>
<td>IS: 432, IS:1139, IS:1786 RSDCL specification</td>
<td>Manufacturers/ VPN approved lab</td>
<td>Review of manufacturers test certificates as well as lab test results by RSDCL</td>
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<td>vii)</td>
<td>Reverse Bend Test for HDS wire</td>
<td>One sample per lot of 5 MT or part thereof for each size</td>
<td>IS: 432 RSDCL specification</td>
<td>Manufacturer/ VPN approved lab</td>
<td>Review of manufacturers test certificates as well as lab test result by RSDCL</td>
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<td>S. No.</td>
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<td>C</td>
<td>STRUCTURAL STEEL USED IN CABLE TRENCHES &amp; FOUNDATIONS</td>
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<td>i)</td>
<td>Dimensional Check</td>
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<td>ii)</td>
<td>Visual Check for damages, rusting, pitting etc.</td>
<td>100%</td>
<td>RSDCL specification &amp; approved drawing</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
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<tr>
<td>iii)</td>
<td>Visual check for welding, defects, primer coating and painting/ galvanizing as applicable</td>
<td>Random</td>
<td>RSDCL specification &amp; approved drawing</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>C</td>
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<tr>
<td>iv)</td>
<td>Physical properties of structural steel</td>
<td>1 sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size</td>
<td>IS: 2062 RSDCL specification &amp; approved drawings</td>
<td>Manufacturer/ RVPN approved lab</td>
<td>Review of Mfgs test certificates as well as lab test results by RSDCL</td>
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<td>2.</td>
<td>GANTRY/ FOUNDATION/ CABLE TRENCH</td>
<td></td>
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</tr>
<tr>
<td>a.</td>
<td>BEFORE EXCAVATION</td>
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</tr>
<tr>
<td>i)</td>
<td>Checking of pegs condition as per line and alignment</td>
<td>100% on each location</td>
<td>IS: 4091, IS: 3764 &amp; RSDCL approved drawings/ specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
</tr>
<tr>
<td>ii)</td>
<td>Checking of pit making as per drawing &amp; RL</td>
<td>100% on each location</td>
<td>IS: 4091, IS: 3764 &amp; RSDCL approved drawings/ specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
</tr>
<tr>
<td>B)</td>
<td>EXCAVATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>i)</td>
<td>Dimensional conformity</td>
<td>Each location</td>
<td>IS: 4091, IS: 3764 &amp; RSDCL approved drawings/ specifications</td>
<td>Bidder</td>
<td>Approval by RSDCL (JMC/MB)</td>
<td>B</td>
</tr>
<tr>
<td>ii)</td>
<td>Vertically/ slopes &amp; squareness of each pit</td>
<td>Each location</td>
<td>IS: 4091, IS: 3764 &amp; RSDCL approved drawings/ specifications</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>B</td>
</tr>
<tr>
<td>iii)</td>
<td>Verification of classification of foundation wherever applicable</td>
<td>Each location</td>
<td>IS: 4091, IS: 3764 &amp; RSDCL approved drawings/ specifications</td>
<td>Joint inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>C)</td>
<td>FOUNDATION BOLTS/ MATALLIC INSERTS</td>
<td></td>
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</tr>
<tr>
<td>i)</td>
<td>Check for proper identification foundation bolts w.r.t. type of foundation</td>
<td>100%</td>
<td>RSDCL specification &amp; approved drawings</td>
<td>Bidder</td>
<td>Checklist to be prepared &amp; signed jointly</td>
<td>C</td>
</tr>
<tr>
<td>ii)</td>
<td>Visual check for mechanical damage and galvanizing painting if applicable for metallic insert</td>
<td>100%</td>
<td>RSDCL specifications &amp; approved drawings</td>
<td>Bidder</td>
<td>Checklist to be prepared &amp; signed jointly</td>
<td>C</td>
</tr>
<tr>
<td>iii)</td>
<td>Alignment &amp; Level</td>
<td>100%</td>
<td>RSDCL specification &amp; approved drawings</td>
<td>Bidder</td>
<td>Checklist to be prepared &amp; signed jointly</td>
<td>B</td>
</tr>
</tbody>
</table>
## Section: FOUNDATION

| S. No. | Component/ operation &
| Description of Test | Sampling Plan with basis | Ref. Document &
| acceptance norm | Testing Agency | Remarks | Check |
|---|---|---|---|---|---|---|---|
| iv) | Grouting/ Underpinning of foundation base plate | 100% | VPN specification & approved drawings | Bidder | Checklist to be prepared & signed jointly | C |
| D) | P.C.C. Padding | For all locations | IS: 456 and RSDCL approved foundation drawings & specification | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| E. | SHUTTERING (Formwork) | 100% | IS: 456, RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | C |
| i) | Check for materials breakage or damage | 100% casting | IS: 456, RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| ii) | Check for plumb, alignment parallelism, squareness and equidistance from stub | 100% casting | IS: 456, RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| iii) | Dimensional check | 100% before casting | IS: 456, RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| iv) | Check for level & height | 100% before casting | RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| v) | Check for rigidity of frame/ tightness | 100% | RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| vi) | Cleaning and oiling | 100% | RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | B |
| Sectio | Component/ operation &
| Description of Test | Sampling Plan with basis | Ref. Document &
<p>| acceptance norm | Testing Agency | Remarks | Check |
| n: Foundation | S. No. | --- | --- | --- | --- | --- | --- |---|
| vii) | Diagonal bracing if required as per drawings/ site conditions | 100% | RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | C |
| viii) | Checking of joints to avoid undue loss of cement slurry | 100% | RSDCL specification/ approved drawings | Joint Inspection by RSDCL and Bidder | Approval by RSDCL | C |</p>
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Percentage</th>
<th>Specification/ Drawings</th>
<th>Inspection Details</th>
<th>Approval Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check)</td>
<td>100%</td>
<td>IS: 456 and RSDCL</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
</tr>
<tr>
<td>ii)</td>
<td>Check as per the bar bending schedule before placement of concrete</td>
<td>For all locations</td>
<td>IS: 456, IS: 2502 and RSDCL</td>
<td>Joint Inspection by RVPN and Bidder (Pour Card)</td>
<td>Approval by RSDCL (Pour Card) B</td>
</tr>
<tr>
<td>iii)</td>
<td>Check cutting tolerance for bars as per check list/drawings. Check whether all the bent bars and lap lengths are as per approved bar bending schedule</td>
<td>For all locations</td>
<td>IS: 456, IS: 2502 and RSDCL</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL (Pour Card) B</td>
</tr>
<tr>
<td>iv)</td>
<td>Check whether all joints &amp; crossing of bars are tied properly with right gauge &amp; annealed wire as per specification</td>
<td>100%</td>
<td>IS: 456 and RSDCL</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
</tr>
<tr>
<td>v)</td>
<td>Check for proper cover distance spacing of bars, spacers &amp; chairs after the reinforcement cage has been put inside the form work</td>
<td>100%</td>
<td>IS: 456 and RSDCL</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
</tr>
<tr>
<td>vi)</td>
<td>Check whether lapping of bars are tied properly by with right gauge and annealed wire as per specification</td>
<td>100%</td>
<td>IS: 456 and RSDCL</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
</tr>
</tbody>
</table>
**Section: FOUNDATION**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Component/ operation &amp; Description of Test</th>
<th>Sampling Plan with basis</th>
<th>Ref. Document &amp; acceptance norm</th>
<th>Testing Agency</th>
<th>Remarks</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>CONCRETING</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>A) APPROVAL OF MIX DESIGN</td>
<td>Each Mix.</td>
<td>IS: 456 &amp; RSDCL approved drawings and specifications</td>
<td>RVPN approved by lab</td>
<td>Approval by RSDCL</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B) BATCHING, MIXING &amp; PLACING OF CONCRETE AND COMPACTING</td>
<td>100%</td>
<td>IS: 456 &amp; RSDCL approved drawings and specifications</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C) FIXING OF CHIMNEY COLUMN</td>
<td>100%</td>
<td>IS: 456 &amp; RSDCL approved drawings and specifications</td>
<td>Joint inspection by RVPN and Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>D) PLACING CONCRETE AND COMPACTING</td>
<td>100%</td>
<td>IS: 456 &amp; RSDCL approved drawings and specifications</td>
<td>Joint Inspection by RSDCL and Bidder</td>
<td>Min gap between boxes and reinforcement bars should be maintained approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>S. No.</td>
<td>Component/ operation &amp; Description of Test</td>
<td>Sampling Plan with basis</td>
<td>Ref. Document &amp; acceptance norm</td>
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<tr>
<td>E)</td>
<td>CONCRETE TESTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Slump Test</td>
<td>One sample per foundation</td>
<td>IS: 456, IS: 516, IS: 1199 and RSDCL specification</td>
<td>Bidder</td>
<td>Approval by RVPN</td>
<td>B</td>
</tr>
<tr>
<td>ii)</td>
<td>Check for quantities for cement, fine aggregate, coarse aggregate and water while batching</td>
<td>100% on all locations</td>
<td>IS: 456, IS: 516, IS: 1199 and RSDCL specification</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>B</td>
</tr>
<tr>
<td>F)</td>
<td>CONCRETE CUBE TESTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Compressive Strength</td>
<td>One sample for every 20 cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength).</td>
<td>IS: 1199, IS: 456, IS: 516 and RSDCL specification</td>
<td>RVPN approved lab</td>
<td>Approval by RSDCL cubes must be tested within a week after 28 days curing period and test results should be approved</td>
<td>A</td>
</tr>
<tr>
<td>G)</td>
<td>CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE &amp; AFTER BOX REMOVAL</td>
<td>100%</td>
<td>IS: 456, IS: 516, IS:1199 and RSDCL specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>4.</td>
<td>BACKFILLING</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>i)</td>
<td>Check for thickness of layer &amp; watering</td>
<td>100%</td>
<td>RSDCL specification and approved drawings</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
</tr>
<tr>
<td>ii)</td>
<td>Visual check for correction/ramming</td>
<td>100%</td>
<td>RSDCL specification and approved drawings</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
</tr>
<tr>
<td>S. No.</td>
<td>Component/ operation &amp; Description of Test</td>
<td>Sampling Plan with basis</td>
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<td>Testing Agency</td>
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<tr>
<td>iii)</td>
<td>Compaction test (percentage of max. dry density)</td>
<td>Gantry foundation 2 samples for each pit. Equipment &amp; other foundation 20% at random</td>
<td>RSDCL specification</td>
<td>RVPN approved lab</td>
<td>Review of lab test results by RSDCL. Elevation for testing to be decided by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>5.</td>
<td>R.R. STONE/ BRICK WORK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Mortar mix/ proportion</td>
<td>Random</td>
<td>IS:2250, RSDCL specification &amp; PWD specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>ii)</td>
<td>Plumb &amp; Alignment</td>
<td>Random</td>
<td>RSDCL. specification &amp; PWD specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>iii)</td>
<td>Joints</td>
<td>Random</td>
<td>RSDCL. specification PWD specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
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<tr>
<td>6.</td>
<td>PLASTERING</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>i)</td>
<td>Plastering thickness and evenness</td>
<td>Random</td>
<td>RSDCL. specification &amp; PWD specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
</tr>
<tr>
<td>ii)</td>
<td>Mortar mix/ proportion</td>
<td>Random</td>
<td>RSDCL. specification &amp; PWD specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>B</td>
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<tr>
<td>7.</td>
<td>CURING FOR CONCRETE, MASONRY, PLASTERING ETC.</td>
<td>100% on all location</td>
<td>IS: 5613 &amp; RSDCL specification</td>
<td>Bidder</td>
<td>Approval by RSDCL</td>
<td>C</td>
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</tbody>
</table>
## Section: FOUNDATION

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Component/operation &amp; Description of Test</th>
<th>Sampling Plan with basis</th>
<th>Ref. Document &amp; acceptance norm</th>
<th>Testing Agency</th>
<th>Remarks</th>
<th>Check</th>
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<tbody>
<tr>
<td>8.</td>
<td>SITE SURFACING</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>i)</td>
<td>Levelling</td>
<td>100%</td>
<td>RSDCL. specification and approved drawings</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>C</td>
</tr>
<tr>
<td>ii)</td>
<td>Soil Sterilisation spraying of chemicals</td>
<td>100%</td>
<td>RSDCL. specification and manufacturers recommendations</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>B</td>
</tr>
<tr>
<td>iii)</td>
<td>Grading of 20/40 mm stone</td>
<td>1 sample per lot of 500 cubic metre or part thereof from each source for each size.</td>
<td>IS:383, IS: 2386 and RSDCL. specification. The grading shall be as per single sized nominal size.</td>
<td>Bidder/ RVPN approved lab</td>
<td>Each source to be approved by RSDCL. Review and acceptance of test results by RSDCL.</td>
<td>B</td>
</tr>
<tr>
<td>iv)</td>
<td>Compacted thickness of 20/40 mm stone layers as applicable</td>
<td>Random</td>
<td>RSDCL. specification and approved drawings</td>
<td>Bidder</td>
<td>Checklist to be prepared and signed jointly</td>
<td>B</td>
</tr>
</tbody>
</table>
STANDARD FIELD QUALITY PLAN FOR CONTROL ROOM & SWITCHYARD CIVIL WORKS

SECTION: GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A, B & C including accepting and deviation dispositioning authorities are indicated at Annexure-10.

2. RSDCL specification shall mean RSDCL technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.

3. Acceptance criteria and permissible limits for certain tests are indicated at Annexure--II. For balance tests, site to verify the same with respect to RVPN specification, relevant Indian Standards and/or prevalent code of practice.

4. It is clarified that the tests indicated at column 2 of the FQP i.e. against column “Component operation & Description of Test”, are only generally required to be conducted. However, RSDCL reserves the right to carry-out any additional tests at any stage if the situation so warrants.

5. RSDCL site representative shall witness all the tests conducted by the Bidder as mentioned in this FQP. However, in case of tests conducted in the RVPN approved lab, it is preferred to witness the tests in the lab itself, if possible.

6. Head of GHO shall approve testing laboratory before accepting the test results from the lab.

7. Head of GHO shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilisation.

8. All the testing & measuring equipments used by the Bidder for testing are required to be calibrated. A copy of valid calibration report shall be retained by RSDCL as records.

9. Classification of foundations shall be approved by RSDCL based on the joint inspection Report & soil investigation reports.

10. Curing of concrete work should be continued for a minimum period of 10 days.

11. ZONE-IV FINE AGGREGATE

11.1 Zone-IV fine aggregate shall be used for nominal mix reinforced cement concreting work.

11.2 Zone-IV fine aggregate shall be avoided for design mix reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval RSDCL site.

12. Bricks should be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

13. CEMENT

13.1 The supply of cement is in the scope of Bidder & the same shall be procured from sources approved by RSDCL Engineer and got tested at site on sample basis for specified acceptance tests as specified in the FQP at a reputed Third Party Lab approved by RSDCL Engineer.

13.2 The makers of cement (O.P.C, 43 Grade) to be used in construction works at substation shall be (i) Vikram (ii) Binani (iii) Birla Uttam (iv) Shree Cement (v) J.K. Cement (vi) Ultra tech.
13.3 The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling. If the cement remains in store for a period of more than six months, all the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS

14.1 The supply of steel is in the scope of the Bidder & the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashtriya Ispat Nigam or the enrollers approved by main producers. The steel shall be got tested at site on sample basis for specified acceptance tests, as specified in this FQP at a reputed Third Party Lab approved by RSDCL Engineer.

14.2 The results of the testing of cement and reinforcement steel referred to in 13.1 and 14.1 above shall be got approved from RSDCL site Engineer before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work, RSDCL site Engineer may authorize the Bidder to use cement and Reinforcement steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the Bidder shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the Bidder by the Project authorities before hand in all such cases.

15. The Bidder shall submit welding procedure specification (WPS) including the type of electrode used for approval of RSDCL Engineer before starting the welding work.

16. Approval/ acceptance of individual test results by RSDCL in the course of execution of contract will not relieve the Bidder of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc. arise due to site conditions, the specific approval of RSDCL may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the Bidder in a manner affording convenient access for identifies and inspection at all times. Storage of material shall be in accordance with IS: 4032 (Latest Edition).

19. AIR CONDITIONING SYSTEM:

The contractor has to provide 5-star split inverter AC Unit (make approved by Director Technical) in Control Room hall, PLCC Room, incharge Room & Rest Rooms as per approved design and standard requirement of units. Including all required Electrification works /items i.e. Power point cabling, electric panel with all accessories, all required plumbing and Civil works complete in all respect at his cost including items mentioned below:

(i) Electric panel along with electric cabling work of required specifications from main source of supply up to terminations and complete.

(ii) False ceiling work as per specification is to be provided where air conditioning is done.

The contractor has to provide design, drawings developed by Standard Consultant based on B.I.S./ I.S. Specifications for air conditioning system (along with make) shall have to be approved from the RSDCL before installation & testing.

20. Location of Pooling Sub Stations & other details required for execution of civil works:

The GPS Co-ordinates of PPS-1, PPS-2, PPS-3 & PPS-4 are as under:
<table>
<thead>
<tr>
<th>NAME OF PPS</th>
<th>COORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPS-1</td>
<td>27° 32' 36.68&quot; N</td>
</tr>
<tr>
<td></td>
<td>72° 14' 30.52&quot; E</td>
</tr>
<tr>
<td>PPS-2</td>
<td>27° 34' 10.15&quot; N</td>
</tr>
<tr>
<td></td>
<td>72° 13' 10.70&quot; E</td>
</tr>
<tr>
<td>PPS-3</td>
<td>27° 35' 15.41&quot; N</td>
</tr>
<tr>
<td></td>
<td>72° 13' 53.23&quot; E</td>
</tr>
<tr>
<td>PPS-4</td>
<td>27° 36' 1.16&quot; N</td>
</tr>
<tr>
<td></td>
<td>72° 14' 23.65&quot; E</td>
</tr>
</tbody>
</table>
RAJASTHAN SOLAR PARK DEVELOPMENT COMPANY LIMITED

TURNKEY PROJECT

SPECIFICATION NO.

RSDCL/ D (T)/SP/ NOKH/PPS/TK/TN -03 (2019-20)

**DRAWINGS**
(for tender purpose)

FOR CONSTRUCTION OF

4 NOS. 220kV PARK POOLING SUB STATIONS AT NOKH SOLAR PARK

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Drawings</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Single Line Diagram PPS-1</td>
</tr>
<tr>
<td>2.</td>
<td>Single Line Diagram PPS-2 &amp; 3</td>
</tr>
<tr>
<td>3.</td>
<td>Single Line Diagram PPS-4</td>
</tr>
<tr>
<td>4.</td>
<td>Electrical Layout Plan PPS-1</td>
</tr>
<tr>
<td>5.</td>
<td>Electrical Layout Plan PPS-2 &amp; 3</td>
</tr>
<tr>
<td>6.</td>
<td>Electrical Layout Plan PPS-4</td>
</tr>
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<td>7.</td>
<td>Structural Layout Plan PPS-1</td>
</tr>
<tr>
<td>8.</td>
<td>Structural Layout Plan PPS-2 &amp; 3</td>
</tr>
<tr>
<td>9.</td>
<td>Structural Layout Plan PPS-4</td>
</tr>
<tr>
<td>10.</td>
<td>Section Drawing</td>
</tr>
<tr>
<td>11.</td>
<td>Earthmat layout Drawing</td>
</tr>
<tr>
<td>12.</td>
<td>Control Room Building Drawing</td>
</tr>
<tr>
<td>13.</td>
<td>Dormitory Building Drawing</td>
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