

## **Tender Notification for**

**Survey, Design, Supply, Installation, Testing and Commissioning including Civil Works of 66/11 kV AIS Grid substation with 2 PTRs on Single point responsibility basis at Bakkarwala**

**NIT NO CMC/BR/22-23/RB/PR/KG/1054 DT 06.08.2022**

**Due Date for Submission: 29.08.2022 1530HRS**

### **BSES RAJDHANI POWER LTD (BRPL)**

Corporate Identification Number: **U74899DL2001PLC111527**

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Website: [www.bsedelhi.com](http://www.bsedelhi.com)

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## SECTION – I: REQUEST FOR QUOTATION

### 1.00 Event Information

BRPL invites sealed tenders in 2 envelopes for following scope of work:

Sl. No.	Description	Estimated Cost (Rs.)	Qty.	Delivery & Installation at
1	Survey, Design, Supply, Installation, Testing and Commissioning including Civil Works of 66/11 kV AIS Grid substation with 2 PTRs on Single point responsibility basis at Bakkarwala	30.17 Crores	As per BOQ Attached	Delhi, Sites

The bidder must qualify the requirements as specified in clause 2.0 stated below.

All envelopes shall be duly super scribed "Survey, Design, Supply, Installation, Testing and Commissioning including Civil Works of 66/11 kV AIS Grid substation with 2 PTRs on Single point responsibility basis at Bakkarwala, New Delhi NIT NO CMC/BR/22-23/RB/PR/KG/1054"

- 1.01 The schedule of specifications with detail terms & conditions can be obtained from address given below against submission of non-refundable demand draft of **Rs.1180/-** drawn in favour of BSES Rajdhani Power Ltd, payable at Delhi. The tender documents & detail terms and conditions can also be downloaded from the website "**www.bsesdelhi.com --> Tenders --> BSES Rajdhani Power Ltd --> Open Tenders**".

In case tender papers are downloaded from the above website, then the bidder has to enclose a demand draft covering the cost of bid documents.

- 1.02 Bids will be received up to 29/08/2021 1530 HRS at the address given at 3.01 below. Part A of the Bid shall be opened on 29/08/2022 1600 HRS.

Part B of the Bid will be opened in case of Techno-Commercially qualified Bidders and the date of opening of same shall be intimated in due course. It is the sole responsibility of the bidder to ensure that the bid documents reach this office on or before the last date.

- 1.03 BSES Rajdhani Power Ltd reserves the right to accept/reject any or all Tenders without assigning any reason thereof in the event of following

- I. Earnest Money Deposit (EMD) of value **Rs 30,17,000/-** is not deposited in shape of Demand Draft/Pay Order/Banker's Cheque /Bank Guarantee drawn in favour of BSES Rajdhani Power Ltd, payable at Delhi.
- II. The offer does not contain prices indicating break-up towards all taxes & duties in prescribed format
- III. Complete Technical details are not enclosed.
- IV. Tender is received after due date and time.
- V. Technical offer contains any prices
- VI. Prices are not FIRM and subject to Price Variation

### 2.0 Qualification Criteria:-

#### Technical

The prospective bidder must qualify all of the following requirements to participate in the bidding process and bidder who meets following requirements will be considered as successful bidder and BRPL has a right to disqualify those bidders who do not meet these requirements.

- a. The bidder must have designed, supplied, installed and commissioned Grid substations of 66 kV or higher rating including civil works on turnkey basis in Five (5) years from date of Bid opening. The list of such installations shall be furnished as per format attached in Schedule-I (List of Installations) of Technical Specification.
- b. Bidder shall procure major equipments from the approved vendor list of BRPL as per technical specifications.
- c. The bidder should have qualified technical & dedicated QA personnel at various stages of manufacture & testing. Documentary evidence in support of QR to be provided.
- d. Bidder shall submit the performance certificates for 1 year satisfactory performance from 2 reputed companies for executed jobs.
- e. The bidder must furnish valid Type Test Certificate carried out at CPRI/ERDA for all major equipment. The Test certificate should not be more than five years old.  
In case type test reports are older than five (5) years from the date of bid opening, bidder shall submit the undertaking that- "since the last type test, the product has not undergone any change in design and the material used and the dimensions of the product are the same as the one on which the type test was conducted".  
Non submission of type test reports will lead to rejection of the offer. In any case, Type test report older than ten (10) years shall not be acceptable and bid is liable for rejection.
- f. The bidder should have established field quality assurance system & safety organization designed to achieve high level of reliability at various stage of field services required for successful erection, testing, & commissioning. Documentary evidence in support of QR to be provided.

**Financial:**

- a. Bidder must have average annual turnover of minimum Rs 50 Crores during last Three (3) financial years i.e. FY 17-18, 18-19 and 19-20, duly certified CA certificate to be submitted. Balance Sheet of 3 financial years also to be provided.
- b. The bidder shall submit a "NO LITIGATION" certificate as per attached format.
- c. The Bidder should possess valid Electrical contractor license issued by competent statutory agency to undertake work in Delhi/NCR. In case bidder is not having this license, Bidder has to give the undertaking that it will be obtained by them before the start of the work at site where copy of valid license shall be submitted to BRPL before the award of the PO.
- d. The bidder must possess valid ISO 9001:2000 certification
- e. An undertaking (self-certificate) that the bidder has not been blacklisted/debarred by any central/state government institution including electricity boards.
- f. The bidder must have valid PAN No., GST No., in addition to other statutory compliances. The bidder must submit the copy of registrations and submit an undertaking that the bidder shall comply with all the statutory compliances as per the applicable laws/rules etc. before the start of the work.

**Note: All reference dates shall be taken as the date of technical bid opening**

Notwithstanding anything stated above, BRPL reserves the right to assess bidder's capability to perform the contract, assess the capability and installed capacity of the Bidder for carrying out the supplies, should the circumstances warrant such assessment in the overall interest of the purchaser. BRPL also reserves the right to evaluate the bidder based on performance of past supplies/projects executed in BRPL. In this regard the decision of the purchaser is final.

### 3.00 **Bidding and Award Process**

Bidders are requested to submit their offer strictly in line with this tender document. **NO DEVIATION IS ACCEPTABLE.** BRPL shall response to the clarifications raised by various bidders and the will be distributed to all participating bidders through website.

#### 3.01 **BID SUBMISSION**

The bidders are required to submit the bids in 2 (two) parts to the following address

**Head of Department  
Contracts & Material Department  
BSES Rajdhani Power Ltd  
1<sup>st</sup> Floor, C Block  
BSES Bhawan, Nehru Place  
New Delhi 110019**

PART A: TECHNICAL **BID** comprising of following (1 original + 1 copy)

- EMD in prescribed format
- Non-refundable demand draft for Rs 1180/- in case the forms are downloaded from website
- Documentary evidence in support of qualifying criteria
- Technical Details / Filled in GTP/Type test report etc
- Qualified Manpower available & Organization Chart
- Testing Facilities
- Copies of Orders, Execution /Performance Certificate & Other Documents to support the QC as per clause 2.0
- Original Tender documents duly stamped & signed on each page as token of acceptance
- Acceptance to Commercial Terms and Conditions viz Delivery schedule/period, Payment terms, PBG etc

PART B: FINANCIAL **BID** comprising of (1 original only)

- Price strictly in the Format enclosed indicating Break up of basic price, taxes & duties, transportation etc

#### 3.02 **TIME SCHEDULE**

The bidders should complete the following within the dates specified as under:

S. No.	Steps	Date
1	Date of sale of bid documents	18.08.2022
2	Pre-Bid meeting	29.08.2022 1430 HRS
3	Pre-Bid meeting ink	<a href="https://bsesbrpl.webex.com/meet/rakesh.bansal">https://bsesbrpl.webex.com/meet/rakesh.bansal</a>
4	Last date of Queries, if any	25.08.2022
5	Last date of receipt of bid documents	29.08.2022 1530HRS
6	Date & time of opening of tender – Part A	29.08.2022 1600HRS

This is a two part bid process. Bidders are to submit the bids in 2(two) parts

Both these parts should be furnished in separate sealed covers super scribing NIT no. DUE DATE OF SUBMISSION, with particulars as **PART-A TECHNICAL BID & COMMERCIAL TERMS & CONDITIONS** and **Part-B FINANCIAL BID** and these sealed envelopes should again be placed in another sealed cover which shall be submitted before the due date & time specified.

**Part – A:** Technical Bid should not contain any cost information whatsoever and shall be submitted within the due date.

**PART B:** This envelope will be opened after techno-commercial evaluation and only of the qualified bidders.

**REVERSE AUCTION:** Purchaser reserves the right to use **REVERSE AUCTION** through SAP-SRM as an optional tool as an integral part of the entire tendering process. All techno-commercially qualified bidders shall participate in this event

Notwithstanding anything stated above, the Purchaser reserves the right to assess bidder's capability to perform the contract, should the circumstances warrant such assessment in the overall interest of the purchaser. In this regard the decision of the purchaser is final.

In case RA is not concluded/conducted for any reasons, a "final no regret" financial bid in a sealed envelope will be called for from all qualified bidders

**BIDS RECEIVED AFTER DUE DATE AND TIME SHALL BE LIABLE TO REJECTION**

**4.00 Award Decision**

4.01 Purchaser intends to award the business on a lowest bid basis, so suppliers are encouraged to submit the bid competitively. The decision to place purchase order/LOI solely depends on purchaser on the cost competitiveness across multiple lots, quality, delivery and bidder's capacity, in addition to other factors that Purchaser may deem relevant.

4.02 In the event of your bid being selected by purchaser (and / or its affiliates) and you subsequent DEFAULT on your bid; you will be required to pay purchaser (and / or its affiliates) an amount equal to the difference in your bid and the next lowest bid on the quantity declared in NIT/RFQ.

4.03 In case any supplier is found unsatisfactory during the delivery process, the award will be cancelled and BRPL reserves the right to award other suppliers who are found fit.

4.04 Qty Variation: The purchaser reserves the rights to vary the quantity by (+/-) 30% of the tender quantity.

**5.00 Market Integrity**

We have a fair and competitive marketplace. The rules for bidders are outlined in the Terms & Conditions. Bidders must agree to these rules prior to participating. In addition to other remedies available, we reserves the right to exclude a bidder from participating in future markets due to the bidder's violation of any of the rules or obligations contained in the Terms & Condition. A bidder who violates the marketplace rules or engages in behavior that disrupts the fair execution of the marketplace shall be restricted from bidding for a length of time, depending upon the seriousness of the violation. Examples of violations include, but are not limited to:

- Failure to honor prices submitted to the marketplace.
- Breach of the terms of the published in Request for Quotation/NIT.

**6.00 Confidentiality**

All information contained in this RFQ is confidential and shall not be disclosed, published or advertised in any manner without written authorization from BRPL. This includes all bidding information submitted.

All RFQ documents remain the property of BRPL and all bidders are required to return these documents to BRPL upon request.

Bidders who do not honor these confidentiality provisions will be excluded from participating in future bidding events.

**7.00 Contact Information**

Technical or Commercial clarifications, if any, as regards this RFQ shall be sought in writing and sent by mail to following address. The same shall not be communicated through phone.

	<b>Technical</b>	<b>Commercial</b>
<b>Contact Person</b>	Mr. Abhinav Srivastava	Mr. Pankaj Goyal
<b>Address</b>	BSES Rajdhani Power Ltd , 1 <sup>st</sup> Floor, BSES Bhawan, Nehru Place, New Delhi 110019	BSES Rajdhani Power Ltd , 1 <sup>st</sup> Floor, D Block, BSES Bhawan, Nehru Place, New Delhi 110019
<b>Email</b>	<a href="mailto:abhinav.r.srivastava@relianceada.com">abhinav.r.srivastava@relianceada.com</a>	<a href="mailto:pankaj.goyal@relianceada.com">pankaj.goyal@relianceada.com</a> <a href="mailto:kumar.ga.gaurav@relianceada.com">kumar.ga.gaurav@relianceada.com</a>

## **SECTION – II: INSTRUCTION TO BIDDERS**

### **1.00 GENERAL**

BSES Rajdhani Power Ltd, hereinafter referred to as "The Company " are desirous of awarding work for "Survey, Design, Supply, Installation, Testing and Commissioning including Civil Works of 66/11 kV AIS Grid substation with 2 PTRs on Single point responsibility basis at Bakkarwala".

### **2.00 SCOPE OF WORK**

The scope of the work is as per BOQ in the tender.

### **3.00 DISCLAIMER**

This Document includes statements, which reflect various assumptions, which may or may not be correct .Each Bidder shall conduct its own estimation and analysis and should check the accuracy, reliability and completeness of the information in this Document and obtain independent advice from appropriate sources in their own interest.

Neither Purchaser nor its employees will have any liability whatsoever to any Bidder or any other person under the law or contract, the principles of restitution or unjust enrichment or otherwise for any loss, expense or damage whatsoever which may arise from or be incurred or suffered in connection with anything contained in this Document, any matter deemed to form part of this Document, provision of Services and any other information supplied by or on behalf of Purchaser or its employees, or otherwise arising in any way from the selection process for the Supply.

Though adequate care has been taken while issuing the Bid document, the Bidder should satisfy itself that Documents are complete in all respects. Intimation of any discrepancy shall be given to this office immediately.

This Document and the information contained herein are Strictly Confidential and are for the use of only the person(s) to whom it is issued. It may not be copied or distributed by the recipient to third parties (other than in confidence to the recipient's professional advisors).

### **4.00 COST OF BIDDING**

The Bidder shall bear all cost associated with the preparation and submission of its Bid and the company will be in no case be responsible or liable for those costs.

### **5.00 BIDDING DOCUMENTS**

The Scope of Work, Bidding Procedures and Contract Terms are described in the Bidding Documents. In addition to the covering letter accompanying Bidding Documents, the Bidding Documents include:

- Request for Quotation (RFQ) - Section - I
- Instructions to Bidders (ITB) - Section - II
- Special Terms & Conditions of Contract (SCC) - Section –III
- General Terms and Condition Supply (GCC-Supply) - Section –IV
- Price Format Supply- Section V
- General Terms and Condition Erection, Testing & Commissioning (GCC-ETC) - Section –VI
- Price Format Erection, Testing & Commissioning - Section VII
- General Terms and Condition –Civil - Section VIII



Price format- Civil – Section IX  
Grand Summary of the Quoted Price – Section X  
Vendor Code of Conduct - Section XI  
Technical Specifications - Annexure I

The Bidder is expected to examine the Bidding Documents, including all Instructions, Forms, Terms and Specifications. Failure to furnish all information required by the Bidding Documents or submission of a Bid not substantially responsive to the Bidding Documents in every respect will may result in the rejection of the Bid.

## 6.00 **AMENDMENT OF BIDDING DOCUMENTS**

At any time prior to the deadline for submission of Bids, the Company may for any reasons, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by amendment.

The Amendment shall be part of the Bidding Documents, pursuant to Clause 5.00, and it will be notified in web site [www.bsesdelhi.com](http://www.bsesdelhi.com), and will be binding on them.

In order to afford prospective Bidders reasonable time in which to take the Amendment into account in preparing their Bids, the Company may, at its discretion, extend the deadline for the submission of Bids. The same shall be published as a corrigendum in website [www.bsesdelhi.com](http://www.bsesdelhi.com).

Purchaser shall reserve the rights to following

- extend due date of submission
- modify tender document in part/whole
- cancel the entire tender

**Bidders are requested to visit website regularly for any modification/clarification/corrigendum/addendum of the bid documents**

## 7.00 **LANGUAGE OF BID**

The Bid prepared by the Bidder, and all correspondence and documents relating to the Bid exchanged by the Bidder and the Purchaser shall be written in the English Language. Any printed literature furnished by the Bidder may be written in another Language, provided that this literature is accompanied by English translation, in which case, for purposes of interpretation of the Bid, the English translation shall govern.

## 8.00 **DOCUMENTS COMPRISING THE BID**

The Bid prepared and submitted by the Bidder shall comprise the following components:

- Bid Form, Price & other Schedules (STRICTLY AS PER FORMAT) and Technical Data Sheets completed in accordance with Technical Specification
- All the Bids must be accompanied with the required EMD as mentioned in the Section-I against each tender.
- Tender documents duly stamped and signed on each page by authorized signatory

## 9.00 **BID FORM**

9.01 The Bidder shall submit one "Original" and one "Copy" of the Un-priced Bid Form, Price Schedules & Technical

Data Sheets duly filled in as per attached specification/BOM etc enclosed.

## 9.02 EMD

The bidder shall furnish, as part of its bid, an EMD amounting as specified in the RFQ. The EMD is required to protect the Purchaser against the risk of Bidder's conduct which would warrant forfeiture.

The EMD shall be denominated in any of the following form:

- (a) Banker's Cheque / Demand Draft/Pay Order drawn in favour of BSES Rajdhani Power Ltd, payable at Delhi.
- (b) Bank Guarantee valid for One hundred Twenty (120) days after due date of submission or amended due date of submission drawn in favour of BSES Rajdhani Power Ltd, BSES Bhawan, Nehru Place, New Delhi 110019

The EMD may be forfeited in case of:

- (a) The Bidder withdraws its bid during the period of specified bid validity

OR

- (b) In the case of a successful Bidder, if the Bidder does not
  - (i) Accept the Purchase Order/ Work Order, or
  - (ii) Furnish the required performance security BG.

## 10.00 BID PRICES

10.01 Bidders shall quote for the entire Scope of Supply/Work with a break-up of prices for individual items and Taxes & Duties. The total Bid Price shall also cover all the Supplier's obligations mentioned in or reasonably to be inferred from the Bidding Documents in respect of Design, Supply, Transportation to site, Erection, testing & commissioning all in accordance with the requirement of Bidding Documents The Bidder shall complete the appropriate Price Schedules included herein, stating the Unit Price for each item & total Price with taxes, duties & freight upto destination.

10.02 The prices offered shall be inclusive of all costs as well as Duties, Taxes and Levies paid or payable during execution of the supply work, breakup of price constituents, should be there. The Bidder is required, at his expense, to obtain all the information he may require to enable him to submit his tender including necessary visits to the site to ascertain the local conditions, procurement of necessary materials, labour, etc., requirements of the local/government/public authorities in such matters.

10.03 Prices quoted by the Bidder shall be **"Firm"** and not subject to any price adjustment during the performance of the Contract. **A Bid submitted with an adjustable price/ Price Variation Clause will be treated as non-responsive and rejected.**

## 11.00 BID CURRENCIES

Prices shall be quoted in Indian Rupees Only.

**12.00 PERIOD OF VALIDITY OF BIDS**

- 12.01 Bids shall remain valid for 120 days from the due date of submission of the Bid & subsequent corrigendum/amendment/extension of due date of submission.
- 12.02 Notwithstanding Clause 12.01 above, the Purchaser may solicit the Bidder's consent to an extension of the Period of Bid Validity. The request and the responses thereto shall be made in writing and sent by post/courier.

**13.00 ALTERNATIVE BIDS**

Bidders shall submit Bids, which comply with the Bidding Documents. Alternative Bids will not be considered. The attention of Bidders is drawn to the provisions regarding the rejection of Bids in the terms and conditions, which are not substantially responsive to the requirements of the Bidding Documents.

**14.00 FORMAT AND SIGNING OF BID**

- 14.01 The original Bid Form and accompanying documents, clearly marked "Original Bid" and "copy" must be received by the Purchaser at the date, time and place specified pursuant to Clauses 15.0 and 16.0. In the event of any discrepancy between the original and the copy, the original shall govern.
- 14.02 The original and copies of the Bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to sign on behalf of the Bidder. **Such authorization shall be indicated by written Power-of-Attorney accompanying the Bid.**
- 14.03 The Bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.

**15.00 SEALING AND MARKING OF BIDS**

- 15.01 Bid submission: One original & one Copy (hard copies) of all the Bid Documents shall be sealed and submitted to the Purchaser before the closing time for submission of the bid.
- 15.02 The Technical Documents and the EMD shall be enclosed in a sealed envelope and the said envelope shall be super scribed with —"Technical & EMD". The price bid shall be inside another sealed envelope with super scribed "Financial Bid ". Both these envelopes shall be sealed inside another big envelope. All the envelopes should bear the Name and Address of the Bidder and marking for the Original and Copy. The envelopes should be super scribed with —"Tender Notice No. & Due date of opening".
- 15.03 The Bidder has the option of sending the Bids in person. Bids submitted by Email/Telex/Telegram /Fax will be rejected. No request from any Bidder to the Purchaser to collect the proposals from Courier/Airlines/Cargo Agents etc shall be entertained by the Purchaser.

**16.00 DEADLINE FOR SUBMISSION OF BIDS**

- 16.01 The original Bid, together with the required copies, must be received by the Purchaser at the address specified earlier.
- 16.02 The Purchaser may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Documents, in which case all rights and obligations of the Purchaser and Bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

**17.00 ONE BID PER BIDDER**

Each Bidder shall submit only one Bid by itself. **No Joint Venture is acceptable.** A Bidder who submits or participates in more than one Bid will cause all those Bids to be rejected.

#### 18.00 **LATE BIDS**

Any Bid received by the Purchaser after the deadline for submission of Bids prescribed by the Purchaser, pursuant to Clause 16.0, will be declared "Late" and shall be rejected and returned unopened to the Bidder.

#### 19.00 **MODIFICATIONS AND WITHDRAWAL OF BIDS**

19.01 The Bidder is not allowed to modify or withdraw its Bid after the Bid's submission.

#### 20.00 **PROCESS TO BE CONFIDENTIAL**

Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process. Any effort by a Bidder to influence the Purchaser's processing of Bids or award decisions may result in the rejection of the Bidder's Bid.

#### 21.00 **CLARIFICATION OF BIDS**

To assist in the examination, evaluation and comparison of Bids, the Purchaser may, at its discretion, ask the Bidder for a clarification of its Bid. All responses to requests for clarification shall be in writing and no change in the price or substance of the Bid shall be sought, offered or permitted.

#### 22.0 **PRELIMINARY EXAMINATION OF BIDS / RESPONSIVENESS**

22.01 Purchaser 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. Purchaser may ask for submission of original documents in order to verify the documents submitted in support of qualification criteria.

22.02 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price per item that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price per item will be corrected. If there is a discrepancy between the Total Amount and the sum of the total price per item, the sum of the total price per item shall prevail and the Total Amount will be corrected.

22.03 Prior to the detailed evaluation, Purchaser will determine the substantial responsiveness of each Bid to the Bidding Documents including production capability and acceptable quality of the Goods offered. A substantially responsive Bid is one, which conforms to all the terms and conditions of the Bidding Documents without material deviation.

22.04 Bid determined as not substantially responsive will be rejected by the purchaser and/or the Purchaser and may not subsequently be made responsive by the Bidder by correction of the non - conformity.

#### 23.00 **EVALUATION AND COMPARISON OF BIDS**

The evaluation of Bids shall be done based on the delivered cost competitiveness basis.

23.01 The evaluation of the Bids shall be a stage-wise procedure. The following stages are identified for evaluation purposes: In the first stage, the Bids would be subjected to a responsiveness check. The Technical Proposals and the Conditional ties of the Bidders would be evaluated.

- 23.02 Subsequently, the Financial Proposals along with Supplementary Financial Proposals, if any, of Bidders with Techno-commercially Acceptable Bids shall be considered for final evaluation.
- 23.03 The Purchaser's evaluation of a Bid will take into account, in addition to the Bid price, the following factors, in the manner and to the extent indicated in this Clause:
- Delivery Schedule
  - Conformance to Qualifying Criteria
  - Deviations from Bidding Documents

Bidders shall base their Bid price on the terms and conditions specified in the Bidding Documents.

The cost of all quantifiable deviations and omissions from the specification, terms and conditions specified in Bidding Documents shall be evaluated. The Purchaser will make its own assessment of the cost of any deviation for the purpose of ensuring fair comparison of Bids.

- 23.04 Any adjustments in price, which result from the above procedures, shall be added for the purposes of comparative evaluation only to arrive at an "Evaluated Bid Price". Bid Prices quoted by Bidders shall remain unaltered.

#### 24.00 **CONTACTING THE PURCHASER**

- 24.01 If any Bidder wishes to contact the Purchaser on any matter related to the Bid, from the time of Bid opening to the time of contract award, the same shall be done in writing only.
- 24.02 Any effort by a Bidder to influence the Purchaser and/or in the Purchaser's decisions in respect of Bid evaluation, Bid comparison or Contract Award, will result in the rejection of the Bidder's Bid.

#### 25.00 **THE PURCHASER 'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS**

The Purchaser reserves the right to accept or reject any Bid and 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 Purchaser's action.

#### 26.00 **AWARD OF CONTRACT**

- 26.01 The Purchaser will award the Contract to the successful Bidder whose Bid has been determined to be the lowest-evaluated responsive Bid, provided further that the Bidder has been determined to be qualified to satisfactorily perform the Contract. Purchaser reserves the right to award order to other bidders in the tender, provided it is required for timely execution of project & provided he agrees to come to the lowest rate.
- 26.02 The Purchaser intends to issue separate Purchase/Work Orders viz
- a) Purchase Order for Supply
  - b) Work Order for Installation, Testing & Commissioning

#### 27.00 **THE PURCHASER 'S RIGHT TO VARY QUANTITIES**

The Purchaser reserves the right to vary the quantity i.e. increase or decrease the numbers/quantities without any change in terms and conditions during the execution of the Order.

#### 28.00 **LETTER OF INTENT/ NOTIFICATION OF AWARD**

The letter of intent/ Notification of Award shall be issued to the successful Bidder whose bids have been

considered responsive, techno-commercially acceptable and evaluated to be the lowest (L1). The successful Bidder shall be required to furnish a letter of acceptance within 7 days of issue of the letter of intent /Notification of Award by Purchaser. The date of LOI/PO shall be treated as Start date of work.

#### 29.00 **CONTRACT PERFORMANCE BANK GAURANTEE**

Within 15 days of the receipt of Notification of Award/ Letter of Intent/PO from the Purchaser, the successful Bidder shall furnish the Performance Bank Guarantee towards faithful performance of Contract for an amount of 10% (Ten percent) of the Contract Price. The Performance Bond shall be valid up to completion period/handing over, whichever is earlier plus 3 months claim period. Upon submission of the performance security, the EMD shall be released. 2 (two) nos. separate CPBG's shall be submitted against Supply, ETC.

#### 30.00 **CORRUPT OR FRADULENT PRACTICES**

30.01 The Company requires that the Bidders observe the highest standard of ethics during the procurement and execution of the Project. In pursuance of this policy, the Company:

(a) Defines, for the purposes of this provision, the terms set forth below as follows:

"Corrupt practice" means behavior on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; and

"Fraudulent practice" means a misrepresentation of facts in order to influence a award process or the execution of a contract to the detriment of the Company, and includes collusive practice among Bidders (prior to or after Bid submission) designed to establish Bid prices at artificial non -competitive levels and to deprive the Company of the benefits of free and open competition.

(b) Will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question ;

(c) Will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a contract.

30.02 Furthermore, Bidders shall be aware of the provision stated in the Terms and Conditions of Contract.

#### 31.00 **COMPLETION PERIOD**

10 Months from the date of PO

02 months: Engineering - Drawing submission & approval and release of civil drawings to site for construction

05 months: Civil Construction at Site and Electrical equipment Manufacturing

03 months: Erection, Testing and Commissioning of electrical equipment and related accessories and handing over

## Section III

### SPECIAL TERMS AND CONDITIONS OF CONTRACT

- 1.1. Bidders are requested to visit the site to understand the scope of work, site conditions and requirements prior to Bidding. Hence, no price/time escalation shall be admissible on these accounts.
- 1.2. The scope of this tender includes supply , survey , design , engineering , manufacturer , shop testing , inspection , packing , dispatch , loading , unloading and storage at site, storage and construction insurance , assembly , erection , structural , complete pre-commissioning checks , testing and commissioning at site , obtaining statutory clearance & certification from state electrical inspector and handing over of Grid to owner on single point responsibility basis.
- 1.3. The scope includes supply of all barricading, free issued materials (including installation, transportation, loading & unloading), dewatering, watch and ward and transportation of scrap (generated at Site), balance free-issued material, dismantled material from site to BRPL store including loading & unloading and no additional charges shall be paid against these activities. Used barricading material will be taken back by bidder soon after job is handed over or as directed by BRPL Engineer-In-Charge (E-I-C). No additional cost for these items will be paid to the Bidder. Any leakage, pilferage and damage of the material shall be in vendor's scope.
- 1.4. Joints & Terminations installation shall only be done by OEM. No additional cost for this item will be paid to the Bidder. Contractor to provide all support to the Jointers for doing Joints & Terminations of Joint Kits.
- 1.5. Prices for all the activities shall be FIRM till the actual completion of the job. Statutory variation will be allowed for direct supplies only wherever breakup of Taxes & Duties are available in Price Bid. In case bidder has not submitted any price breakup, no variation on account of statutory variation shall be paid extra by BRPL.
- 1.6. There will be no price escalation given to bidder even if there is delay in the project due to ROW permission.
- 1.7. Permission from road owning agencies & statutory clearance for road cutting shall be taken by Bidder. The Bidder shall follow-up with local authorities and other connected persons that may require carrying out the job under this work order.
- 1.8. Electrical Inspector Clearance fees shall be in Bidder's scope. The related fees, payments and pursuance work shall be in scope of Bidder only.
- 1.9. Bidder has to submit the technical parameters with details of Spares for each rating with catalogue, reference codes etc.
- 1.10. Wherever BRPL specifications are not available relevant IS/IEC to be followed. All Drawings mentioned in the Tender Specification and other required for the completeness of the tender shall be submitted. Drawing submission process shall not be deemed complete if all the requirements are not complied during the submission of the same.
- 1.11. The bidder should have own testing equipment's/they have to provide like IR Tester, Hi Pot Test Kit, Earth Tester, etc with Calibration Certificates for testing.
- 1.12. The Bidder should have own Safety equipment like Neon Tester, Portable Earth, Earthing discharge rod etc. along with Calibration Certificates of all the equipment.

- 1.13. The Bidder should have all major tools and tackles required for installation, testing & commissioning works.
- 1.14. Bidder has to submit the item wise price bifurcation in bid. Un-priced copy must be attached with the Part A. Reverse Auction will be carried out on Lump sum Basis/Total Landed Cost i.e. Supply + ETC+ Civil.
- 1.15. Any other material not specifically mentioned above but required for successful commissioning and operation is in the scope of bidder. Prior approval shall be taken from central engineering department before execution. Commercial approval shall be taken from C&M Department before execution.
- 1.16. Successful bidder has to adhere to the statutory compliance.
- 1.17. Successful Bidder has to depute the safety officer and quality officer separately at site for whole duration and they have to submit the safety report and quality report to BRPL E-I-C on weekly basis.
- 1.18. Successful bidder has to send the weekly progress report to BRPL EIC.
- 1.19. In case of any major deviation, deletion or addition which bidder may feel is relevant to this project & for its safe operation and completion of works; Bidder may clearly highlight and communicate the same to the purchaser with his bid.
- 1.20. Necessary Statutory Clearances from CEI of Delhi & any other authority for energizing shall be in the scope of this tender.
- 1.21. After commissioning of the complete system and final approval of Electrical Inspector & Compliance to punch points observed to the satisfaction of Projects as per statutory requirements, system shall be handed over to BRPL.
- 1.22. **Guarantee period/Defect Liability period:**

The Guarantee Period will be equipment/service/work specific and shall be as specified in the Technical Specifications for the equipment/material/service/work and where Technical specifications are not part of contract documents or guarantee period is not specified in the Technical specifications, the guarantee period shall be as per the Special Terms and Conditions of the Contract. In case of no mention of the guarantee period in Technical specifications, Defect liability period will be 24 Months from the Date of Commissioning or 30 months from the date of delivery of final lot of supplies made, whichever is later.

If during the defects liability period any materials / items are found to be defective, these shall be replaced or rectified by the bidder at his own cost within 30 days from the date of receipt of intimation

**1.23. Failure during Guarantee Period:**

If the equipment and material supplied/service or work rendered under the contract fails to perform its due, rated & intended quality performance, during the Guarantee period, the bidder is liable to undertake repair/rectify/replace the equipment and material supplied/service or work rendered under the contract within time frame as specified below at bidder's cost to make the equipment and material supplied/service or work rendered under the contract of performing its due, rated and intended quality performance. If bidder fails to repair/rectify/replace the equipment or material supplied/service or work rendered under the contract, failed in Guarantee Period, purchaser will be at liberty to get the same done at bidder's risks and costs and recover all such expenses plus the purchaser own charges (@ 15% of expenses incurred), from the bidder or from the "Performance Bank Guarantee" as the case may be.

If during the Warranty/ Guarantee period some parts of the supplies are replaced owing to the defects/ damages under the Warranty, the Warranty period for such replaced parts shall be until the expiry of twelve



months from the date of such replacement or renewal or until the end of original Guarantee period, whichever is later.

- a) Service Engineer Availability to Attend, Identify & Restore Defects (Minor) of materials/Equipment's under Guarantee Period within 48 Working Hours (Exclusion of Material Support Cases)
- b) Spare Material Delivery for rectification of defect (Major) Under Guarantee Period within Two Weeks. Bidder must keep Requisite Inventory of Critical Spares & Other Equipments Covered in Guarantee Period to Restore Equipment within Two Weeks.
- c) In Case Of Complete Replacement of material, within a Period of 4 Weeks.

**Note:** BRPL is in the business of Power distribution and is committed to providing reliable and continuous power supply to its customers. In case of any fault in the system, BRPL's top most priority is to rectify the fault and restore the system as soon as possible and maintain the supply.

If during the defect liability period any fault occurs in the system due to faulty materials, design or workmanship, BRPL shall intimate the vendor of such occurrence for taking immediate corrective action.

However, if the situation, in BRPL's sole discretion warrants an emergency restoration, it reserves the right to take immediate action for identifying the fault and restoring the system with available resources & materials or with help from any other third party agency under intimation to the Vendor. All costs of replacement, substitution, shipping, labour and other related expenses including taxes and levies incurred in connection with the restoration of fault plus 15% of expenses incurred as administrative overheads shall be for the account of Vendor. BRPL will charge the vendor for the costs incurred for fault restoration or may set off such costs against any amounts payable by BRPL to the Vendor or deduct from the PBG submitted by the Vendor. Vendor shall pay BRPL the amount within 30 days.

Root cause analysis of the fault shall be done jointly by BRPL's CES & O&M teams and Vendor. In case the fault is due to any reason other than faulty materials, design or workmanship, Vendor shall be exempted from any further action or Cost.

- 1.24. All the bay equipment (i.e- LA, CT, PT, Disc Insulator, String, Suspension Insulator, Bushing etc.) shall be Polymeric type in the place of porcelain with creepage 31mm/kV. Rest of the parameter to be followed as per tech spec.

#### 1.25. PROJECT INFORMATION & COMPLETION

The contractor shall be fully responsible to complete the project in time. It is desired that the project should be completed as per the schedule from the date of LOI or purchase order whichever is earlier. The detailed completion schedule shall be prepared by vendor and shall be submitted at the time of detailed engineering for approval. Vendor has to submit the progress report fortnightly with this tender/as asked by the Purchaser.

#### 1.26. PROJECT IMPLEMENTATION & EXECUTION CONTROL

The bidders are requested to submit the following along with the bid, about the project implementation & execution methodology.

- a) Write up/overview of project Plan
- b) Implementation Methodology
- c) Project Organization Chart for Representatives, Project Office & site office teams along with the functions.
- d) Bar Chart & Network Diagram (with critical path) for various activities to achieve scheduled completion.

## **SECTION IV GENERAL TERMS AND CONDITIONS - SUPPLY**

- 1.01** All the Bids shall be prepared and submitted in accordance with these instructions.
- 1.02** Bidder shall bear all costs associated with the preparation and delivery of its Bid, and the Purchaser will in no case shall be responsible or liable for these costs.
- 1.03** The Bid should be submitted by the Bidder in whose name the bid document has been issued and under no circumstances it shall be transferred /sold to the other party.
- 1.04** The Purchaser reserves the right to request for any additional information and also reserves the right to reject the proposal of any Bidder, if in the opinion of the Purchaser, the data in support of RFQ requirement is incomplete.
- 1.05** The Bidder is expected to examine all instructions, forms, terms & conditions and specifications in the Bid Documents. Failure to furnish all information required in the Bid Documents or submission of a Bid not substantially responsive to the Bid Documents in every respect may result in rejection of the Bid. However, the Purchaser's decision in regard to the responsiveness and rejection of bids shall be final and binding without any obligation, financial or otherwise, on the Purchaser.
- 2.0 Definition of Terms**
- 2.01** "Purchaser" shall mean BSES Rajdhani Power Limited, on whose behalf this bid enquiry is issued by its authorized representative / officers.
- 2.02** "Bidder" shall mean the firm who quotes against this bid enquiry issued by the Purchaser. "Supplier" or "Supplier" shall mean the successful Bidder and/or Bidders whose bid has been accepted by the Purchaser and on whom the "Letter of Acceptance" is placed by the Purchaser and shall include his heirs, legal representatives, successors and permitted assigns wherever the context so admits.
- 2.03** "Supply" shall mean the Scope of Contract as described.
- 2.04** "Specification" shall mean collectively all the terms and stipulations contained in those portions of this bid document known as RFQ, Commercial Terms & Condition, Instructions to Bidders, Technical Specifications and the Amendments, Revisions, Deletions or Additions, as may be made by the Purchaser from time to time.
- 2.05** "Letter of Acceptance" shall mean the official notice issued by the Purchaser notifying the Supplier that his proposal has been accepted and it shall include amendments thereto, if any, issued by the Purchaser. The "Letter of Acceptance" issued by the Purchaser shall be binding on the "Supplier" The date of Letter of Acceptance shall be taken as the effective date of the commencement of contract.
- 2.06** "Month" shall mean the calendar month and "Day" shall mean the calendar day.
- 2.07** "Codes and Standards" shall mean all the applicable codes and standards as indicated in the Specification.
- 2.08** "Offer Sheet" shall mean Bidder's firm offer submitted to BRPL in accordance with the specification.
- 2.09** "Contract" shall mean the "Letter of Acceptance/Purchase Order" issued by the Purchaser.
- 2.10** "Contract Price" shall mean the price referred to in the "Letter of Acceptance/Purchase Order".

- 2.11** "Contract Period" shall mean the period during which the "Contract" shall be executed as agreed between the Supplier and the Purchaser in the Contract inclusive of extended contract period for reason beyond the control of the Supplier and/or Purchaser due to force majeure.
- 2.12** "Acceptance" shall mean and deemed to include one or more of the following as will be stipulated in the specification:
- The written acceptance of material by the inspector at suppliers works to ship the materials.
  - Acceptance of material at Purchaser site stores after its receipt and due inspection/ testing and release of material acceptance voucher.
  - Where the scope of the contract includes supplying, acceptance shall mean issue of necessary equipment / material takeover receipt after installation & commissioning and final acceptance.

### **3.0 Contract Documents & Priority**

Contract Documents: The terms and conditions of the contract shall consist solely of these RFQ conditions and the offer sheet. The several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies, the same shall be explained and adjusted by the Purchaser, who shall thereupon issue to the Contractor, instructions thereon. In such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as follows:

- Any amendments to Contract
- Commercial Terms & Conditions of the Contract
- Clarifications/addendum/corrigendum to Tender
- Terms & Conditions of the Tender

### **4.0 Scope of Supply -General**

- 4.01 The "Scope of Supply" shall be on the basis of Bidder's responsibility, completely covering the obligations, responsibility and supplies provided in this Bid enquiry whether implicit or explicit.
- 4.02 Bidder shall have to quote for the Bill of quantities as listed elsewhere.
- 4.03 All relevant drawings, data and instruction manuals.

### **5.0 Quality Assurance and Inspection**

- 5.01 Immediately on award of contract, the bidder shall prepare detailed quality assurance plan/test procedure identifying the various stages of manufacture, quality checks performed at each stage, raw material inspection and the Customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards / values and get the approval of Purchaser before proceeding with manufacturing. However, Purchaser shall have right to review the inspection reports, quality checks and results of suppliers in house inspection department which are not Customer hold points and the supplier shall comply with the remarks made by purchaser or his representative on such reviews with regards to further testing, rectification or rejection, etc. In case of standard items, BRPL shall forward the standard QAP which is to be followed by vendor during manufacturing.
- 5.02 Witness and Hold points are critical steps in manufacturing, inspection and testing where the supplier is obliged to notify the Purchaser in advance so that it may be witnessed by the Purchaser. Final inspection is a mandatory hold point. The supplier can proceed with the work past a hold point only after clearance by purchaser or a witness waiver letter from BRPL.
- 5.03 The performance of waiver of QA activity by Purchaser at any stage of manufacturing does not relieve the supplier of any obligation to perform in accordance with and meet all the requirements of the procurement documents and also all the codes & reference documents mentioned in the procurement document nor shall it preclude subsequent rejection by the purchaser.

- 5.04 On completion of manufacturing the items can only be dispatched after receipt of dispatch instructions issued by the Purchaser.
- 5.05 All in-house testing and inspection shall be done without any extra cost. The in-house inspection shall be carried out in presence of BRPL/BRPL authorized third party inspection agency. Cost of Futile/abortive visit(s) shall be debited from the invoices
- 5.06 Purchaser reserves the right to send any material being supplied to any recognized laboratory for testing, wherever necessary and the cost of testing shall be borne by the Bidder. In case the material is found not in order with the technical requirement / specification, the charges along with any other penalty which may be levied is to be borne by the bidder. To avoid any complaint the supplier is advised to send his representative to the stores to see that the material sent for testing is being sealed in the presence of bidder's representative.

## **6.0 Packing, Packing List & Marking**

- 6.01 **Packing:** Supplier shall pack or shall cause to be packed all Commodities in crates/boxes/drums/containers/cartons and otherwise in such a manner as shall be reasonably suitable for shipment by road or rail to BRPL, Delhi/New Delhi stores/site without undue risk of damage in transit.
- 6.02 **Packing List:** The contents of each package shall be itemized on a detailed list showing the exact weight, extreme outside dimensions (length, width & weight) of each container/box/drum/carton, Item SAP Code, PO No & date. One copy of the packing list shall be enclosed in each package delivered.

## **7.01 Price basis for supply of materials**

Bidder has to quote their prices on Landed Cost Basis and quote separate price for each item.

FIRM prices for supply to BRPL Delhi/New Delhi stores inclusive of packing, forwarding, loading at manufacturer's premises, payment of all taxes, GST, Freight, any other local charges etc.

The above supply prices shall also include unloading at BRPL Delhi/New Delhi stores/site.

Transit insurance will be arranged by bidder.

## **8.0 Terms of payment and billing – SUPPLY**

- a) 10% advance against submission of BG of equivalent amount valid up to completion period/handing over , whichever is earlier plus 3 months claim period. In case of delay, the BG shall be extended suitably.
- b) 75% pro-rata of supply value shall be payable against R/A bills for supply of equipment and materials within 30 days against receipt of material at site and submission of following documents duly certified by BRPL Project-in-charge:
- i. Consignee copy of LR
  - ii. Detailed invoice showing commodity description, qty, unit & total price,
  - iii. Original certificate issued by BRPL confirming receipt of material at site & acceptance
  - iv. Dispatch clearance & inspection report issued by the inspection authority
  - v. Packing List, Test Reports
  - vi. Guarantee Certificate.
- c) 10% pro-rata after installation/erection of equipment duly certified by BRPL Project-in-charge

- d) 5% pro-rata after completion of successful acceptance testing, commissioning and Handing Over of the entire Installation and duly certified by BRPL Project-in-charge and submission of PBG of 10% of contract value valid up to Defect Liability period i.e. 24 months from the date of Handing over of entire Installation Plus 3 months towards Claim period.

**9.0 Price Validity**

- 9.01 All bids submitted shall remain valid, firm and subject to unconditional acceptance by BRPL Delhi for 120 days from the due date of submission & subsequent corrigendum/amendment/extension of due date of submission. For awarded suppliers/contractors, the prices shall remain valid and firm till contract completion.

**10.0 Performance Guarantee**

- 10.01 Bank guarantee shall be drawn in favour of "BSES Rajdhani Power Ltd" as applicable. The performance Bank guarantee shall be in the format as specified by BRPL.
- 10.02 Contract performance bank guarantee of total 10% of the contract price shall be submitted within 15 days of award of contract with the validity till completion of the contract period.
- 10.03 Contractor shall submit the performance bank guarantee equivalent to the 10% of the contract value at the time of claiming the last payment as per clause no. 8.0(C) (Terms of payment and billing – SUPPLY), with the validity of the bank guarantee till Defect Liability Period plus 3 months towards Claim period.

**11.0 Forfeiture**

- 11.01 Each Performance Bond established under Clause 10.0 shall contain a statement that it shall be automatically and unconditionally forfeited without recourse and payable against the presentation by BRPL of this Performance Bond, to the relevant bank referred to above, together with a simple statement that supplier has failed to comply with any term or condition set forth in the Contract.
- 11.02 Each Performance BG established under will be automatically and unconditionally forfeited without recourse if BRPL at its sole discretion determines that supplier has failed to comply with any term or condition set forth in the contract.

**12.0 Release**

All Performance Bonds will be released without interest within seven (7) days from the last date up to which the Performance Bond has to be kept valid (as defined in Clause 10.0) except for the case set forth in Clause 21.0.

**13.0 Guarantee of Performance**

The bidder shall stand guarantee that the equipment and material supplied/service or work rendered under the contract is free from design, manufacturing, material, construction, erection & installation and workmanship & quality defects and is capable of its due, rated and intended quality performance, as an integrated product delivered under the contract for a specific period termed as Guarantee Period. The bidder should also guarantee that the equipment/material is new and unused except for the usage required for the tests and checks required as part of quality assurance.

#### **14.0 Guarantee Period/Defects Liability Period**

The Guarantee Period will be equipment/service/work specific and shall be as specified in the Technical Specifications for the equipment/material/service/work and where Technical specifications are not part of contract documents or guarantee period is not specified in the Technical specifications, the guarantee period shall be as per the Special Terms and Conditions of the Contract. In case of no mention of the guarantee period in Technical specifications, Defect liability period will be 24 Months from the Date of Commissioning or 30 months from the date of delivery of final lot of supplies made, whichever is later.

If during the defects liability period any materials / items are found to be defective, these shall be replaced or rectified by the bidder at his own cost within 30 days from the date of receipt of intimation.

Cost of repairs on failure in Guarantee Period:

The cost of repairs/rectification /replacement, apart from the actual cost of repairs/rectification/replacement is also inclusive of all bidder costs of required transportation, site inspection /mobilization/dismantling and re-installation costs as applicable, to be borne by the bidder. The bidder has to ensure that the interruption in the usage of intended purpose of the equipment is minimized to the maximum extent In lieu of the time taken for repairs/rectification/replacement.

#### **15.0 Latent Defect:**

Hidden defects in manufacturing or design of the product supplied and which could not be identified by the tests conducted but later manifested during operation of the equipment are termed as latent defects. Bidder shall further be responsible for 'free replacement' for another period of FIVE years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Purchaser.

#### **16.0 Support beyond the Guarantee Period**

The Bidder shall ensure availability of spares and necessary support for a period of at least 10 years post completion of guarantee period of equipment /technology supplied against this contract. BRPL shall be duly intimated by the Vendor of End of Life Support for the product /technology supplied at least 12 months in advance.

#### **17.0 Return, Replacement or Substitution**

BRPL shall give Supplier notice of any defective Commodity promptly after becoming aware thereof. BRPL may at its discretion elect to return defective Commodities to Supplier for replacement, free of charge to BRPL, or may reject such Commodities and purchase the same or similar Commodities from any third party. In the latter case BRPL shall furnish proof to Supplier of the cost of such substitute purchase. In either case, all costs of any replacement, substitution, shipping, labour and other related expenses incurred in connection with the return and replacement or for the substitute purchase of a Commodity hereunder should be for the account of Supplier. BRPL may set off such costs against any amounts payable by BRPL to Supplier. Supplier shall reimburse BRPL for

the amount, if any, by which the price of a substitute Commodity exceeds the price for such Commodity as quoted in the Bid.

**18.0 Effective Date of Commencement of Contract:**

The date of the issuance of the Letter of Acceptance/Purchase Order shall be treated as the effective date of the commencement of Contract.

**19.0 Time – The Essence of Contract**

The time and the date of completion of the "Supply" as stipulated in the Letter Of Acceptance / Purchase order issued to the Supplier shall be deemed to be the essence of the "Contract". The Supply has to be completed not later than the aforesaid Schedule and date of completion of supply.

**20.0 The Laws and Jurisdiction of Contract:**

The laws applicable to this Contract shall be the Laws in force in India. To the best of their ability, the parties hereto shall endeavor to resolve amicably between themselves all disputes arising in connection with this work order. If the same remain unresolved within thirty (30) days of the matter being raised by either party, either party may refer the dispute for adjudication by arbitration. The arbitration shall be undertaken by the sole arbitrator jointly appointed by the parties. In case the parties fail to arrive at consensus to appoint the sole arbitrator, either party may approach the Court for appointing an arbitrator under Section 11 of the Arbitration and Conciliation Act, 1996 and the award of the said sole arbitrator, shall be final and binding upon the parties. The arbitration proceeding shall be conducted in accordance with this provisions of the Indian Arbitration & Conciliation Act, 1996 (as amended up to date) and the venue of such arbitration shall be the city of New Delhi only. The Arbitration shall be conducted in English language only. The courts at Delhi shall have the exclusive jurisdiction over the subject matter of Arbitration/dispute. The cost of the Arbitration shall be equally shared by the parties as per directions of the Sole Arbitrator.

**21.0 Events of Default**

21.01 Events of Default. Each of the following events or occurrences shall constitute an event of default ("Event of Default") under the Contract:

- (a) Supplier fails or refuses to pay any amounts due under the Contract;
- (b) Supplier fails or refuses to deliver Commodities conforming to this RFQ/ specifications, or fails to deliver Commodities within the period specified in P.O. or any extension thereof
- (c) Supplier becomes insolvent or unable to pay its debts when due, or commits any act of bankruptcy, such as filing any petition in any bankruptcy, winding-up or reorganization proceeding, or acknowledges in writing its insolvency or inability to pay its debts; or the Supplier's creditors file any petition relating to bankruptcy of Supplier;
- (d) Supplier otherwise fails or refuses to perform or observe any term or condition of the Contract and such failure is not remediable or, if remediable, continues for a period of 30 days after receipt by the Supplier of notice of such failure from BRPL.

**22.0 Consequences of Default**

- (a) If an Event of Default shall occur and be continuing, BRPL may forthwith terminate the Contract by written notice.
- (b) In the event of an Event of Default, BRPL may, without prejudice to any other right granted to it by law, or the Contract, take any or all of the following actions;
  - (i) present to Bank for forfeiture to the relevant bank the Performance Bond;
  - (ii) Purchase the same or similar Commodities from any third party; and/or
  - (iii) Recover any losses and/or additional expenses BRPL may incur as a result of Supplier's default.

**23.0 Liquidated Damages**

- 23.01 If supply of items / equipment is delayed beyond the supply schedule as stipulated in LOI/PO, then the Supplier shall be liable to pay the Purchaser for delay a sum of 0.5% (half percent) of the total price for every week of delay or part thereof for undelivered units.
- 23.02 The total amount for delay under the contract will be subject to a maximum of ten percent (10%) of the total contract value.
- 23.03 The Purchaser may, without prejudice to any method of recovery, deduct the amount for such damages from any amount due or which may become due to the Supplier or from the Performance Bond or file a claim against the supplier. The levy payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Supply on time or from any other part of his obligation and liabilities under the Contract. Once the maximum is reached, the Company reserves the right for termination of contract without any liabilities to the Company.

In the event of an extension of time being granted by the EIC, in writing for the Completion of the works, this clause shall be applicable after the expiry of such an extended period.

**24.0 Statutory variation in Taxes and Duties**

The total order value shall remain **FIRM** within stipulated delivery period and shall not be adjusted on account of any price increase/variations in commodities & raw materials. However Statutory Taxes, duties and Levies imposed by Competent Authorities by way of fresh notification(s) within the stipulated delivery period shall be borne by BRPL on submission of necessary documents claiming such variation. The variation will be applicable only on such value wherever price breakup of same is submitted by vendor/available in PO/WO

**25.0 Force Majeure**

## 25.01 General

An "Event of Force Majeure" shall mean any event or circumstance not within the reasonable control directly or indirectly, of the Party affected, but only if and to the extent that:

- (i) Such event or circumstance materially and adversely affects the ability of the affected Party to perform its obligations under this Contract, and the affected Party has taken all reasonable precautions, due care



and reasonable alternative measures in order to prevent or avoid the effect of such event on the affected party's ability to perform its obligations under this Contract and to mitigate the consequences thereof.

- (ii) For the avoidance of doubt, if such event or circumstance would not have materially and adversely affected the performance of the affected party had such affected party followed good industry practice, such event or circumstance shall not constitute force majeure.
- (iii) Such event is not the direct or indirect result of the failure of such Party to perform any of its obligations under this Contract.
- (iv) Such Party has given the other Party prompt notice describing such events, the effect thereof and the actions being taken in order to comply with above clause.

25.02 Specific Events of Force Majeure subject to the provisions of above clause, Events of Force Majeure shall include only the following to the extent that they or their consequences satisfy the above requirements:

- (i) The following events and circumstances:
  - a) Effect of any natural element or other acts of God, including but not limited to storm, flood, earthquake, lightning, cyclone, landslides or other natural disasters.
  - b) Explosions or fires
- (ii) War declared by the Government of India, provided that the ports at Mumbai are declared as a war zone.
- (iii) Dangers of navigation, perils of the sea.

25.03 Notice of Events of Force Majeure If a force majeure event prevents a party from performing any obligations under the Contract in part or in full that party shall:

- i) Immediately notify the other party in writing of the force majeure events within 7(seven) working days of the occurrence of the force majeure event
- ii) Be entitled to suspend performance of the obligation under the Contract which is affected by force majeure event for the duration of the force majeure event.
- iii) Use all reasonable efforts to resume full performance of the obligation as soon as practicable
- iv) Keep the other party informed of all such efforts to resume full performance of the obligation on a regular basis.
- v) Provide prompt notice of the resumption of full performance or obligation to the other party.

25.04 Mitigation of Events of Force Majeure Each Party shall:

- (i) Make all reasonable efforts to prevent and reduce to a minimum and mitigate the effect of any delay occasioned by an Event of Force Majeure including recourse to alternate methods of satisfying its obligations under the Contract;
- (ii) Use its best efforts to ensure resumption of normal performance after the termination of any Event of Force Majeure and shall perform its obligations to the maximum extent practicable as agreed between the Parties; and
- (iii) Keep the other Party informed at regular intervals of the circumstances concerning the event of Force Majeure, with best estimates as to its likely continuation and what measures or contingency planning it is taking to mitigate and or terminate the Event of Force Majeure.

25.05 Burden of Proof In the event that the Parties are unable in good faith to agree that a Force Majeure event has occurred to an affected party, the parties shall resolve their dispute in accordance with the provisions of this Agreement. The burden of proof as to whether or not a force Majeure event has occurred shall be upon the party claiming that the force majeure event has occurred and that it is the affected party.

25.06 Termination for Certain Events of Force Majeure. If any obligation of any Party under the Contract is or is reasonably expected to be delayed or prevented by a Force Majeure event for a continuous period of more than 3 months, the Parties shall promptly discuss in good faith how to proceed with a view to reaching a

solution on mutually agreed basis. If a solution on mutually agreed basis cannot be arrived at within a period of 30 days after the expiry of the period of three months, the Contract shall be terminated after the said period of 30 days and neither Party shall be liable to the other for any consequences arising on account of such termination.

- 25.07 The Purchaser may terminate the contract after giving 7(seven) days notice if any of following occurs:
- Contractor fails to complete execution of works within the approved schedule of works, terms and conditions
  - In case the contractor commits any Act of Insolvency, or adjudged insolvent
  - Has abandoned the contract
  - Has failed to commence work or has suspended the progress of works
  - Has failed to proceed the works with due diligence and failed to make such due progress
- 25.08 Limitation of Force Majeure event. The Supplier shall not be relieved of any obligation under the Contract solely because cost of performance is increased, whether as a consequence of adverse economic consequences or otherwise.
- 25.09 Extension of Contract Period due to Force Majeure event The Contract period may be extended by mutual agreement of Parties by way of an adjustment on account of any period during which an obligation of either Party is suspended due to a Force Majeure event.
- 25.10 Effect of Events of Force Majeure. Except as otherwise provided herein or may further be agreed between the Parties, either Party shall be excused from performance and neither Party shall be construed to be in default in respect of any obligations hereunder, for so long as failure to perform such obligations shall be due to an event of Force Majeure."

## **26.0 Transfer and Sub-Letting**

The Supplier shall not sublet, transfer, assign or otherwise part with the Contract or any part thereof, either directly or indirectly, without prior written permission of the Purchaser.

## **27.0 Recoveries**

When ever under this contract any money is recoverable from and payable by the bidder, the purchaser shall be entitled to recover such sum by appropriating in part or in whole by deducting any sum due to which any time thereafter may become due from the supplier in this or any other contract. Should the sum be not sufficient to cover the full amount recoverable the bidder shall pay to the purchaser on demand the remaining balance.

## **28.0 Waiver**

Failure to enforce any condition herein contained shall not operate as a waiver of the condition itself or any subsequent breach thereof.

## **29.0 Indemnification**

Notwithstanding contrary to anything contained in this RFQ, Supplier shall at his costs and risks make good any loss or damage to the property of the Purchaser and/or the other Supplier engaged by the Purchaser and/or the employees of the Purchaser and/or employees of the other Supplier engaged by the Purchaser whatsoever arising out of the negligence of the Supplier while performing the obligations under this contract.

## **30.0 Documentation:**

The Bidder's shall procure all equipment from BRPL approved sources as per attached specifications. The Bidder's shall submit 5 copies of Material/Type Test Certificates, O&M Manuals, and Approved & As-built drawings. The Bidder's shall ensure for the strict compliance to the specifications and Field Quality Procedures issued by BRPL Engineer in-charge.

**31.0 Commissioning Spares**

Commissioning Spares shall be deemed to be included in the quoted prices

**32.0 Limitation on Liability**

Notwithstanding anything to the contrary in the Purchase Order but subject to clause 33 Consequential Damages, the aggregate liability of either Party to the other Party in respect of all claims for Liabilities arising under the Purchase Order shall not exceed the aggregate value of the Purchase Order(s) under which the Liabilities arose except that such limitation shall not apply to the Contractor's indemnification obligations in accordance with clause 29 Indemnification herein.

**33.0 Consequential Damages**

Notwithstanding anything to the contrary in the Purchase Order, except for breach of obligations under Non-disclosure and except as expressly provided in a Purchase Order, in no event, as a result of breach of contract or breach of warranty or otherwise, shall either Party hereto or either Party's Affiliates or sub Contractors, be liable under the Purchase Order to the other Party for any consequential, special, indirect, exemplary or incidental damages, and/or for any lost profits, goodwill or revenues of such Party, howsoever arising, before or after Acceptance of the Goods and whether or not such damages are foreseeable.

## SECTION V

**PRICE FORMAT – SUPPLY**

<b>66/11kV Bakkakrwalā SS with 2 PTR with provision of 3rd PTR supply</b>								
<b>S.N o.</b>	<b>Item Description</b>	<b>Quant ity</b>	<b>UOM</b>	<b>Basic (Rs)</b>	<b>Freight (Rs)</b>	<b>GST (Rs)</b>	<b>Unit Land ed (Rs)</b>	<b>Total Land ed Cost (Rs)</b>
1	66/11KV 31.5 MVA Power Transformer including NIFPS	2	Set					
2	AL Pipe bus bar	1	Lot					
3	66kV 3 Pole SF6 circuit Breaker along with support structures	8	Nos					
4a	66kV Current Transformer (1600-800/1-1-1-1A)	12	Nos					
4b	66kV Current Transformer (2000/1-1A)	3	Nos					
4c	66kV Current Transformer (400-200/1-1-1-1A)	9	Nos					
5	66kV Potential Transformer	6	Nos					
6	66kV CVT	12	Nos					
7a	Horizontally Rotating double break motorized isolators with one earth switch (2000A)	13	Nos					
7b	Horizontally Rotating double break motorized isolators with one earth switch (1250A)	3	Nos					
8	Horizontally rotating double break motorized isolator with 2 earth switch	2	Nos					
9	Horizontally rotating double break motorized Tendem isolator without earth switch	7	Nos					
10	Bay Marshaling Kiosk	8	Nos					
11	Galvanized lattice type Gantry structure with tower and Beam including Civil work	1	Lot					
12	String bus including twin zebra ACSR conductor for bus coupler and jumpering	1	Lot					
13	Double and single suspension tension string hardware assembly for Quard Zebra	1	Lot					
14	Support Structure for all equipments including post insulators	1	Lot					
15	Station aux Transformer 11/0.433kV 400kVA	1	No					
16	66kV Control Relay Panel							
16a	66kV Control Relay Panel Line Feeder	4	Set					
16b	66kV Control Relay Panel Transformer Feeder	3	Set					
16c	66kV Control Relay Panel Bus coupler Feeder	1	Set					
17	220V Li-Ion Battery bank	1	Set					

18	DCDB with battery charger	1	Nos					
19	ACDB	1	Nos					
20	11kV APFC 4 Stage, 7.2 MVAR capacitor bank with motorized isolator	2	Sets					
21	11kV APFC 2 Stage, 3.6 MVAR capacitor bank with motorized isolator	2	Sets					
22	66kV single phase gapless metal oxide surge arrester	21	Nos					
23	66kV Bus Post Insulator including civil work	1	Lot					
24	Cable Mounting Structure including civil work	4	Set					
25	LA Mounting Structure including civil work	21	Nos					
26	SCADA RTU	1	Set					
27	11kV VCB switchgear with numerical protective relays(as per SLD)		Set					
27a	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Incoming	4	Set					
27b	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Buscoupler	2	Set					
27c	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- outgoing	30	Set					
27d	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Station Transformer	1	Set					
27e	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Capacitor (7.2 MVAR)	2	Set					
27f	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Capacitor (3.6 MVAR)	2	Set					
27g	11kV VCB switchgear Bus PT with riser with numerical protective relays(as per SLD)	2	Set					
27h	11kV VCB switchgear Bus PT Panel with numerical protective relays(as per SLD)	2	Set					
27i	Earthing trucks for 11KV Panels -Bus Earthing Truck	2	Set					
27j	Earthing trucks for 11KV Panels -Cable Earthing Truck	2	Set					
28	Grounding and earthing of entire substation including earthing of transformer fence and capacitor bank fence	1	Set					
29	High mast lighting 16M for Lighting cum Lightening Protection	4	Nos					
30	Indoor LED lighting system including emergency lighting	1	Lot					
31	Air conditioning for complete substation building except Toilet and Pantry	1	Lot					
32	Exhaust and Ventillation for Toilet, Pantry	1	Lot					
33	Building and outdoor lightning protection system	1	Lot					

34	Control cables including terminations and Glands							
a	6CX4Sqmm	2000	Mtr					
b	6CX2.5Sqmm	8000	Mtr					
c	10CX2.5Sqmm	8000	Mtr					
35	LT power cable including terminations and Glands							
a	2CX10Sqmm	1000	Mtr					
b	4CX10Sqmm	1000	Mtr					
c	4CX300Sqmm	100	Mtr					
d	2CX2.5Sqmm	1200	Mtr					
e	4CX95Sqmm	100	Mtr					
f	1CX16Sqmm	50	Mtr					
36	11kV Power cable termination kits along with Glands qty							
a	11KV 3CX400Sqmm I/D cable termination	14	Nos					
b	11KV 1CX1000Sqmm I/D cable termination	42	Nos					
37	Fire detection and alarm system for building	1	Lot					
38	Spacers,Connectors, C- Wedge Connectors and Clamps as per requirement with 10% Spare	1	Lot					
39	Cable trays as per requirement	1	Lot					
40	Cabling between equipments and RTU as per requirement	1	Lot					
41	Fire Extinguisher as per spec	1	Lot					
42	Outdoor LED Lighting including street lighting with poles as per spec	1	Lot					
43	Line current differential relay including all accessories like patch cord, LIU with junction box for remote location as per spec	4	Nos					
44	Video Surveilence system as per spec	1	Set					
45	Cable entry sealing as per requirement	1	lot					
46	Cable Mounting Structure for 11kV Cables from Transformer	2	Set					
47	Fire Suppression System of 11KV Panels	1	lot					
48	IT Requirements as per spec/BOQ	1	Lot					
49	Merging unit for installing process bus including all accessories	1	Lot					
50	Spares & maintenance tools & Tackles ( as per specs)	1	Lot					

**BOQ shall be read in conjunction with the Tender Document & General Design Criteria**

**Appendix- I****COMMERCIAL TERMS AND CONDITIONS - SUPPLY**

Sl No	Item Description	AS PER BRPL	BIDDER'S CONFIRMATION
1	Validity	120 days from the due date of submission or amended due date of submission	
2	Price basis	a) <b>Firm</b> , FOR Delhi store basis. Prices shall be inclusive of all taxes & duties, freight up to Delhi stores. b) Unloading at stores - in vendor's scope c) Transit insurance in Bidder scope	
3	Payment terms	a. 10% advance against submission of BG of equivalent amount valid up to completion period/handing over, whichever is earlier plus 3 months claim period. In case of delay, the BG shall be extended suitably. b. 75 % against R/A bills within 30 days against receipt of material at site. c. 10% pro-rata after installation/erection of equipment d. 5% pro-rata after completion of successful acceptance testing, commissioning and Handing Over of the entire Installation and duly certified by BRPL Project-in-charge and submission of BG of 10% of contract value valid up to Defect Liability period i.e. 24 months from the date of Handing over of entire Installation Plus 3 months towards Claim period	
4	Completion time	10 months from date of LOI/Order	
5	Defect Liability period	24 months from the date of Handing over of entire Installation.	
6	Liquidated damages	0.5% of total price for every week delay subject to maximum of 10% of total contract value	
7	Contract Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to completion period/handing over.	
8	Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to Defect Liability Period plus 3 months towards claim period.	

**SECTION VI****GENERAL TERMS & CONDITIONS - ERECTION, TESTING & COMMISSIONING****1. DEFINITIONS and INTERPRETATION**

The following terms shall have the following meanings:

1.1 "Company": means BSES Rajdhani Power Ltd, a company incorporated under the Companies Act 1956 and having its office at BSES Bhawan, Nehru Place, New Delhi 110 019, which expression shall include its authorized representatives, agents, successors and assigns.

1.2 "Contractor": shall mean the successful Bidder / vendor to whom the contract has been awarded

1.3 "Rate": The unit rates for the work to be carried out at site shall be as per finalized unit rates through tender. The finalized rates shall be firm for the entire duration of work to be carried out by the Contractor under the work order and are not subject to escalation for any reason whatsoever.

1.4. Contract Specification: The terms "Contract Specification" shall mean the Technical specification of the work as agreed by you and description of work as detailed in Annexure-I enclosed herewith and all such particulars mentioned directly/referred to or implied as such in the contract.

1.5 SITE: The terms "Site" shall mean the working location in BRPL area. Under this tender, working location shall be as mentioned elsewhere.

1.6 ENGINEER IN CHARGE: "Engineer In-charge" means the Company's authorized representative for the purpose of carrying out the work.

**2. EXAMINATION OF SITE AND LOCAL CONDITIONS:**

The contractor is deemed to have visited the site of the work and ascertained therefore all site conditions and information pertaining to his work. The company shall not accept any claim whatsoever arising out of the difficult site/terrain/local conditions, if any.

**3. LANGUAGE AND MEASUREMENT:**

The Contract issued to the contractor by the company and all correspondence and documents relating to the Contract placed on the Bidder shall be written in English language.

Metric System shall be followed for all dimension, units etc.

**4. SCOPE OF WORK:**

The scope includes survey , design , engineering , manufacture , shop testing ,inspection , packing , dispatch , loading, unloading and storage at site, storage and construction insurance , assembly , erection ,structural , complete pre-commissioning checks , testing and commissioning at site , obtaining statutory clearance & certification from state electrical inspector, Municipal Corporation department (if required), Fire Officer (if required), Horticulture department (if required), and handing over to owner after successful testing & Commissioning of 66/11 kV AIS Substation at Bakkarwala, New Delhi, BRPL on single point responsibility basis. Schedule of work shall be as per BOQ attached herewith.

After completion of E/T/C work of the scheme, Bidder has to obtain the Electrical Inspectorate's Clearance from the Electrical Inspector of Delhi Govt. Electrical Inspector Clearance fees shall be in Bidder's scope. The related fees, payments and pursuance work shall be in scope of Bidder only.



Bidder shall arrange any permission like road cutting clearance, if required, etc from the Delhi Civic authorities. The Bidder shall follow-up with local authorities and other connected persons that may be required to carry out the job under this work order.

All the labour, cranes, tool and tackles, and technical supervision etc. are including in your scope of work. Adequate number of engineers, supervisors and laborers shall be posted at site and the list of the same along with certificate of Qualification of technical staff should be submitted by the Bidder to the Engineer In Charge for checking the adequacy immediately (within seven days) after award of contract.

The Bidder shall also make his own arrangement for the accommodation/conveyance requirements for its staff at site. Company will be provided at site the adequate open space for Bidder's site store for storing the materials, tools, tackles etc. The entire Bidder's storage will be within the site premises. All the incoming and outgoing materials, equipment, tools, tackles and any other items related to said work shall be entered into the register kept for this purpose and shall be in the custody of Bidder, however company does not hold any responsibility for any loss or damage of Bidder's material etc.

All loading/unloading, of materials at work-site shall be Bidder's responsibility. Involvement of Crane/Hydra/Tractor/Trailer for this type of work shall be in your scope. Adequate weather protection shall be provided by the Bidder to keep the materials safe from sun & rain by providing covered storage space as well as using tarpaulins.

The Bidder at his own shall arrange Water and Electricity Power at his cost.

**Special Instruction:-**

- a. All Erection tools and tackles and testing equipment shall be available with Bidder in event of order.
- b. Penalty clause shall be incorporated in case any of workmen of Bidder is found violating safety protocol as per GCC-ETC LD Clause no 15.

Any additional work beyond the scope enumerated in the work order above shall be carried out as per the instructions of Engineer-In Charge. The company shall not entertain any claim or increase in the Work Order value due to execution of such additional work if the same is not approved by Engineer in Charge.

**5. RATES:**

The rates finalized for this order shall be firm for the entire duration of work carried out by the Bidder under the order and are not subject to any variation and escalation for any reason whatsoever.

The cost of insurance during loading/unloading of materials/ equipments during its storage and handling/erection at site for installation is included in the Bidder's scope and value shall be included in the unit rates finalized.

The unit rates finalized is also inclusive of barricading and watch & ward during execution and no separate charges shall be paid for the same.

**6. TAXES AND DUTIES:**

Prices are inclusive of all taxes and duties including GST as applicable. However, IT as per applicable rate will be deducted from your bills as Tax Deduction at Source (TDS).

The total order value shall remain **FIRM** within stipulated delivery period and shall not be adjusted on account of any price increase/variations in labour. However Statutory Taxes, duties and Levies imposed by Competent Authorities by way of fresh notification(s) within the stipulated delivery period shall be borne by BRPL on submission of necessary documents claiming such variation. The variation will be applicable only on such value wherever price breakup of same is submitted by vendor/available in PO/WO.

## **7. TERMS OF PAYMENT (Erection, Testing & Commissioning)**

Payment shall be made as under:

(i) 10% mobilization advance against submission of Advance Bank Guarantee of equivalent amount valid up to completion period/ handing over, whichever is earlier plus 3 months claim period. In case of delay, the BG shall be extended suitably.

ii) 75% pro-rata of total installation value shall be payable against R/A bills payable within 45 days after installation / erection of material at site duly certified by Engineer in charge.

iii) 10% pro-rata of total installation value shall be payable against R/A bills payable within 30 days after testing & commissioning of material at site.

iv) 5% of contract value payable after completion of successful acceptance testing, commissioning and handing over of complete systems duly certified by Engineer in charge, submission of Electrical Inspector Clearance Certificate & submission of Performance Bank Guarantee of 10% of contract value valid up to defect liability period i.e. 24 months from the date of Handing over of entire Installation Plus 3 months towards Claim period.

All the Bank guarantees shall be submitted as per Company's format (Appendix I) and from any scheduled Bank approved by Company.

Company shall make payments of the bills either; By crossed cheque or by electronic transfer directly to Bidder's designated bank account.

## **8. Guarantee of Performance**

The bidder shall stand guarantee that the equipment and material supplied/service or work rendered under the contract is free from design, manufacturing, material, construction, erection & installation and workmanship & quality defects and is capable of its due, rated and intended quality performance, as an integrated product delivered under the contract for a specific period termed as Guarantee Period. The bidder should also guarantee that the equipment/material is new and unused except for the usage required for the tests and checks required as part of quality assurance.

## **9. Guarantee period/Defect Liability period:**

The Guarantee Period will be equipment/service/work specific and shall be as specified in the Technical Specifications for the equipment/material/service/work and where Technical specifications are not part of contract documents or guarantee period is not specified in the Technical specifications, the guarantee period shall be as per the Special Terms and Conditions of the Contract. In case of no mention of the guarantee period in Technical specifications, Defect liability period will be 24 Months from the Date of Commissioning or 30 months from the date of delivery of final lot of supplies made, whichever is later.

If during the defects liability period any materials / items are found to be defective, these shall be replaced or rectified by the bidder at his own cost within 30 days from the date of receipt of intimation.

## **10. Performance Guarantee**

10.01 Bank guarantee shall be drawn in favour of "BSES Rajdhani Power Ltd" as applicable. The performance Bank guarantee shall be in the format as specified by BRPL.

10.02 Contract performance bank guarantee of total 10% of the contract price shall be submitted within 15 days of award of contract with the validity till completion of the contract period.

10.03 Bidder shall submit the performance bank guarantee equivalent to the 10% of the contract value at the time of claiming the last payment as per clause no. 7.0 (iii) (TERMS OF PAYMENT (Erection, Testing & Commissioning)), with the validity of the bank guarantee till Defect Liability Period i.e. 24 months from the date of Handing over of entire Installation plus 3 months.

## **11. COMPLETION PERIOD**

You are required to mobilize your manpower and Tools & Tackles and furnish a list of equipments to be used for erection and commence the execution activity as per instructions of Engineer In-charge. The entire Erection, Testing & Commissioning work should be completed within 08 months from the date of issue of LOI/WO. The detailed schedule and milestone completion dates would be as per the contract schedules given from time to time by Engineer In-charge at site. You shall submit a weekly progress report to Engineer In charge.

## **12. CLEANLINESS**

All debris shall be removed and disposed of at assigned areas on daily basis. Surplus excavated earth shall be disposed of in an approved manner. In short, you shall be fully responsible for keeping the work site clean at all times. In case of non-compliance, company shall get the same done at Bidder's risk and costs.

## **13. COMMISSIONING & ACCEPTANCE TEST:**

After completion of the work, the Bidder shall conduct trial run/ operation in the presence of Engineer In charge. During such trial run the system shall be operated under the supervision of the Bidder. If any rectification/modification required during this period the Bidder shall do all necessary measures.

On satisfactory completion of above, the system shall be deemed to have energized and placed in commercial operation. The Engineer-in-Charge will issue an acceptance certificate.

## **14. WORK COMPLETION CERTIFICATION, HANDING OVER.**

The work carried out by the Bidder under this order has to be certified by Engineer In-charge for satisfactory completion of work allotted to the Bidder with respect to specifications / Field Quality Procedures as per applicable standards. In case of modification/correction to be carried out, Bidder shall carry out the said modifications/correction without additional cost. The Bidder shall remain in close contact with Engineer In-Charge at site to report the general findings of the fieldwork during the initial as well as later stage of the work at site.

The Bidder shall be solely responsible for any shortage or damage of materials issued to them handling of and / or in storage and erection at site and cost of the same will be recovered from the Bidder as certified by Engineer In-Charge. Bidder must submit a periodical material reconciliation statement in the approval format with every Running Bill raise by him or end of every month whichever is earlier. The Bidder shall maintain an accurate and exhaustive record detailing

out the list of all items received by him for the purpose of erection and keep such record open for the inspection of the company.

### **15. PENALTY AND LIQUIDATED DAMAGES**

15.1 Penalty: A penalty of 2.5% of bill amount shall be levied in each case of non-compliance of safety practices and site cleanliness.

15.2 Liquidated Damages: In the event of any delay in completion of the work beyond the stipulated time given by in order due to reasons solely attributable to the Bidder, the Bidder shall pay to the Company liquidated damages.

If the Bidder failed perform the services within the time period specified in the order, the Company shall, without prejudice to its other remedies under the contract, deduct liquidated damages a sum equivalent to 0.5 % of the total order value for each week or part there of delay until the actual date of completion up to a maximum deduction of 10% of total order value. The levy payment or deduction of such damages shall not relieve the Bidder from his obligation to complete the Works on time or from any other part of his obligation and liabilities under the Contract. Once the maximum is reached, the Company reserves the right for termination of contract without any liabilities to the Company.

In the event of an extension of time being granted by the EIC, in writing for the Completion of the works, this clause shall be applicable after the expiry of such an extended period.

Engineer In charge should specifically mention the amount of LD levied on the bill of Bidder.

### **18. SAFETY REGULATIONS & SAFETY CODE:**

The Bidder shall indemnify the Company from any consequence arising due to Bidder's failure in respect to safety compliance.

First Aid facilities at easily accessible place shall be provided by the Bidder at his own cost as per provisions of Labor act or as advised by the Company wherever works are carried out.

All critical injuries shall be reported promptly to the Company. The report shall cover type, nature, cause, physician's report and actions for prevention of those types again.

To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Bidder shall be open to inspection by the Company.

The cost so incurred by the Bidder in providing for safety standards and requirements as above shall be deemed to be included in the rates quoted for various items under the scope of Contract and no extra amounts shall be payable to the Bidder on this account.

The Bidder shall furnish to the Company within seven days from issue of Work Order whichever is earlier, for approval of Company, the proposed safety program on how it intends to implement the safety procedures and precautions to ensure that the site is accident free.

The Bidder shall ensure adequate safety precautions at site as required under the law of the land and shall be entirely responsible for the complete safety of their workman as well as other workers at site and premises. The Bidder shall not deploy any worker below the age of 18 years.

The Bidder shall observe the safety requirements as laid down in the contract and in case of sub-contract (only after written approval of company), it shall be the responsibility of main Bidder that all safety requirements are followed by the employees and staff of the sub-vendor.

The Bidder employing two hundred employees or more, including contract workers, shall have a safety coordinator in order to ensure the implementation of safety requirements of the contract and a Bidder with lesser number of employees, including contract workers, shall nominate one of his employees to act as safety coordinator who shall liaise with the safety officer on matters relating to safety and his name shall be displayed on the notice board at a prominent place at the work site.

The Bidder shall be responsible for non-compliance of the safety measures, implications, injuries, fatalities and compensation arising out of such situations or incidents.

In case of any accident, the Bidder shall immediately submit a statement of the same to the owner and the safety officer, containing the details of the accident, any injury or casualties, extent of property damage and remedial action taken to prevent recurrence and in addition, the Bidder shall submit a monthly statement of the accidents to the owner at the end of each month.

### **17. STATUTORY OBLIGATIONS:**

The Bidder shall take all steps as may be necessary to comply with the various applicable laws/rules including the provisions of contract labour (Regulation & Abolition Act) 1970 as amended, minimum wages Act, 1984, Workman Compensation Act, ESI Act, PF Act, Bonus Act and all other applicable laws and rules framed there under including any statutory approval required from the Central/State Govt. Ministry of Labour. Broadly, the compliance shall be as detailed below, but not limited to:

- a) An Electrical license issued by Govt.of Delhi.
- b) PF Code No. and all employees to have PF A/c No. under PF every Act, 1952.
- c) All employees to have a temporary or permanent ESI Card as per ESI Act.
- d) ESI Registration No.
- e) PAN No.
- f) Work Contract Tax Registration Number/ GSTN Registration.
- g) Labour License under Contract Labour Act (R & A) Act 1970

(The Bidder shall provide BRPL Engineer-in-charge a copy of Labour License responsible for execution of the job before start of the work.)

The Bidder must follow:

- a) Third party Insurance Policy before start of work.
- b) To follow Minimum Wages Act prevailing in the state.
- c) Salary / Wages to be distributed in presence of representative of Company's representative not later than 7th of each month.
- d) To maintain Wage- cum - Attendance Register.
- e) To maintain First Aid Box at Site.
- f) Latest P.F. and E.S.I. challans pertaining to the period in which work was undertaken along with a certificate mentioning that P.F. and E.S.I. applicable to all the employees has been deducted and deposited with the Authorities within the time limits specified under the respective Acts.
- g) Workman Compensation Policy. {If applicable}
- h) Labour license before start of work. {If applicable}

### **18. WORKMAN COMPENSATION:**

The Contactor shall take insurance policy under the Workman Compensation Act to cover such workers who are not covered under ESI and PF by the Bidder however engaged to undertake the jobs covered under this order and a copy of this insurance policy will be given to Company for reference and records. This insurance policy shall be kept valid at all

times. In case there are no worker involve other than those who are covered under ESI and PF by the Bidder, the Bidder shall certify for the same.

The Bidder shall keep the company indemnified at all times, against all claims of compensation under the provision of Workmen Compensation Act 1923 and as amended from time to time or any compensation payable under any other law for the time being workman engaged by the Bidder/sub-contractor/sub-agent in carrying out the job involved under this work order and against costs and expenses, if any, incurred by the company in connection therewith and without prejudice to make any recovery.

The company shall be entitled to deduct from any money due to or to become due to the Bidder, moneys paid or payable by way of compensation as aforesaid or cost or expenses in connection with any claims thereto and the Bidder shall abide by the decision of the Company as to the sum payable by the Bidder under the provisions of this clause.

### **19. STAFF AND WORKMAN**

It shall be responsibility of Bidder

(a) To obtain Contract Labour License from the concerned authorities and maintain proper liaison with them. Necessary Forms for obtaining Labour License would be issued by the company. However you will bear all expenses for obtaining Labour license and registration in PF Department for your scope of work. You will deposit PF of your staff/laborer each month and all related documents should be furnished to us.

b) To obtain workman insurance cover against deployment of workers etc.

(II) To maintain, proper records relating to workmen employed, in the form of various Registers, namely,

- a) Register of workmen.
- b) Register of muster roll.
- c) Register of overtime.
- d) Register of wages.
- e) Any other register as per latest amendment Labour Act.

The records shall be in the prescribed formats only.

(III) To disburse monthly wages to your workers/ supervisors in time and in the presence of Company representatives or as directed by the Labour authorities.

(IV) To maintain proper liaison with the Project authorities, local police and all other government and local bodies.

(V) To pay your workmen at least not less than the minimum prescribed wages as per state/Central Labour laws as may be, applicable. The Bidder shall, be responsible for compliance of all the provisions of minimum Wages Act, PF, ESIC Act workmen Compensation Act and Contract Labour Regulation & Abolition Act the rules made there under. In case of non-compliance of the statutory requirements, the company would take necessary action at the risk and cost of the Bidder.

(VI) To employ required number of skilled/semi-skilled and unskilled workmen as per site requirement to complete the entire project as per schedule. To provide safety shoes, safety helmets, safety belts, gloves etc. to your worker/staff as per requirement during erection work.

(VII) To employ necessary engineering and supervisory staff for completion of the Project in time. While day-to-day management of the site and supervision of the works shall be the responsibility of your Engineer - In charge, he will report to the Engineer in charge to assist him to discharge the overall responsibility of the execution of the project.

**20. INSURANCE****a) THIRD PARTY INSURANCE**

Before commencing the execution of the work the Bidder shall take third party insurance policy at his own cost to insure against any damage or loss or injury which may occur to any property/public property or to any person or any employee or representative of any outside Agency / the company engaged or not engaged for the work of the company, by or arising out of the execution of the work or temporary work or in carrying out of this Agreement. For third party insurance policies, the Bidder shall be responsible for settlement of claims with the underwriters without any liability on the purchaser / owner and will arrange replacements / rectification expeditiously without awaiting settlement by insurance claim at Bidders own cost.

**b) ACCIDENTAL INSURANCE POLICY FOR LIFE COVER:**

Before commencing the execution of the work, the Bidder shall take Accidental insurance policy for the staff engaged by him for this work to insure against any loss of life which may occur during the contract for the work of the Company. The policy shall have coverage of Rs. 10 Lacs (Table C- Death + Permanent Total Disability + Partial permanent Disability due to external accidents). The Bidder shall be responsible for on the spot same day claim settlement with the victim's legal heirs without waiting for settlement by insurance claim without any liability on BRPL. The premium amount for such life cover policy shall be borne by the Bidder. The Bidder shall furnish copy of policy when demanded by BRPL.

**c) INSURANCE FOR MAN, MATERIAL & MACHINERY DEPLOYED AT SITE**

Bidder shall be responsible for the insurance for his own man, material and machinery deployed at site for the package awarded. Bidder shall furnish the copy of this insurance policy to the purchaser, prior start of work.

**21. SECURITY**

Adequate number of trained Security Guards shall be deployed both at the storage yard and stores as well as places of work to prevent theft and pilferage of material and accessories and various other materials. All security rules and safety rules enforced at site by company shall be strictly observed.

**22. ENVIRONMENTAL, HEALTH & SAFETY PLAN:**

Bidder will make ensure that the Environment, Health & Safety (EHS) requirements are clearly understood and faithfully implemented at all levels at site as per instruction of Company. Bidders must comply with these requirements:

- a) Comply with all of the elements of the EHS Plan and any regulations applicable to the work
- b) Comply with the procedures provided in the interests of Environment, Health and Safety
- c) Ensure that all of their employees designated to work are properly trained and competent
- d) Ensure that all plant and equipment they bring on to site has been inspected and serviced in accordance with legal requirement and manufacturer's or suppliers' instructions
- e) Make arrangements to ensure that all employees designated to work on or visit the site present themselves for site induction prior to commencement of work
- f) Provide details of any hazardous substances to be brought onsite

g) Ensure that a responsible person accompanies any of their visitors to site

All Bidders staffs are accountable for the following:

1. Use the correct tools and equipment for the job and use safety equipment and protective clothing supplied, e.g. helmets, goggles, ear protection, etc. as instructed
2. Keep tools in good condition
3. Report to the Supervisor any unsafe or unhealthy condition or any defects in plant or equipment
4. Develop a concern for safety for themselves and for others
5. Prohibit horseplay
6. Not to operate any item of plant unless they have been specifically trained and are authorized to do so.

### **23. TEST CERTIFICATE & QUALITY ASSURANCE:**

The Bidder shall procure all equipment from genuine sources as approved by the Company and as per Company specifications. The Bidder shall submit all the test certificates and joint inspection reports related to major equipment wherever applicable. The Bidder shall ensure for the strict compliance to the specifications and Field Quality Procedures issued by company / Engineer in-charge.

### **24. SUB-CONTRACTING / SUBLETTING:**

BIDDER shall not assign or transfer the whole or any part of this Work Order or any other benefits accruing there from nor shall it subcontract / sublet the whole or any part of the Works without the prior written consent of COMPANY.

In the event the Bidder assigns this work order, Bidder's assignees shall be bound by the terms and conditions of this work order and shall, if deemed necessary by COMPANY at the time of such assignment, undertake in writing to be so bound by this Work Order.

Notwithstanding the subletting / subcontracting of any portion of the works, Bidder shall remain wholly responsible for the carrying out, completion and satisfactory execution of Works in all respects in accordance with this Work Order, specification, approved drawings and data sheets.

### **25. INDEMNITY:**

Bidder shall indemnify and save harmless COMPANY against and from any and all liabilities, claims, damages, losses or expenses arising due to or resulting from:

- A. Any breach non-observance or non-performance by Bidder or its employees or agents of any of the provisions of this Work Order.
- B. Any act or omission of Bidder or its employees or agents.
- C. Any negligence or breach of duty on the part of Bidder, its employees or agents including any wrongful use by it or them of any property or goods belonging to or by COMPANY or any other third party at site including adjoining neighbors.

Bidder shall at all times indemnify COMPANY against all liabilities to other persons, including the employees or agents of COMPANY or Bidder for bodily injury, damage to property or other loss which may arise out of or in consequence of the execution or completion of Works and against all costs charges and expenses that may be occasioned to COMPANY by the claims of such person.

### **26. EVENTS OF DEFAULTS:**

COMPANY may, without prejudice to any of its other rights or remedies under the Work Order or in law, terminate the whole or any part of this Work Order by giving written notice to the Bidder, if in the opinion of COMPANY, Bidder has



neglected to proceed with the works with due diligence or commits a breach of any of the provisions of this work order including but not limited to any of the following cases:

- a) Failing to complete execution of work within the terms specified in this work order.
- b) Failing to complete works in accordance with the approved schedule of works.
- c) Failing to meet requirements of specifications, drawings, and designs as approved by COMPANY.
- d) Failing to comply with any reasonable instructions or orders issued by COMPANY in connection with the works.
- e) Failing to comply with any of the terms or conditions of this work order.

In the event COMPANY terminates this work order, in whole or in part, on the occurrence of any event of default, COMPANY reserves the right to engage any other sub-vendor agency to complete the work or any part thereof, and in addition to any other right COMPANY may have under this work order or in law including without limitation the right to penalize for delay under clause 15.0 of this tender, the contractor shall be liable to COMPANY for any additional costs that may be incurred by COMPANY for the execution of the Work.

## **27. RISK & COST:**

If the Contractor fails to execute the work as per specification / as per the direction of Engineer's In-charge within the scheduled period and even after the extended period, the contract shall get cancelled and company reserves the right to get the work executed from any other source at the Risk & Cost of the Contractor. The Extra Expenditure so incurred shall be debited to the Contractor.

## **28. ARBITRATION:**

To the best of their ability, the parties hereto shall endeavor to resolve amicably between themselves all disputes arising in connection with this LOA. If the same remain unresolved within thirty (30) days of the matter being raised by either party, either party may refer the dispute for settlement by arbitration. The arbitration is to be undertaken by two arbitrators, one each to be appointed by either party. The arbitrators appointed by both the parties shall mutually nominate a person to act as presiding arbitrator before entering upon the reference in the event of a difference between the two arbitrators and the award of the said presiding arbitrator in such a contingency shall be conducted in accordance with the provisions of the Indian Arbitration & Conciliation Act, 1996 and the venue of such arbitration shall be in the city of New Delhi only.

## **29. FORCE MAJEURE:**

### 29.1 General:

An "Event of Force Majeure" shall mean any event or circumstance not within the reasonable control, of the Party affected, but only if and to the extent that:

(i) Such event or circumstance, despite the exercise of reasonable diligence, could not have been prevented, avoided or reasonably foreseen by such Party;

(ii) Such event or circumstance materially and adversely affects the ability of the affected Party to perform its obligations under this Contract, and the affected Party has taken all reasonable precautions, due care and reasonable alternative measures in order to prevent or avoid the effect of such event on the affected parties ability to perform its obligations under this Contract and to mitigate the consequences thereof. For the avoidance of doubt, if such event or circumstance would not have materially and adversely affected the performance of the affected party had such affected party followed good industry practice, such event or circumstance shall not constitute force majeure.

(iii) Such event is not the direct or indirect result of the failure of such Party to perform any of its obligations under this Contract; and

(iv) Such Party has given the other Party prompt notice describing such events, the effect thereof and the actions being taken in order to comply with above clause

#### 29.2 Specific Events of Force Majeure:

Subject to the provisions of above clause, Events of Force Majeure shall include only the following to the extent that they or their consequences satisfy the above requirements:

The following events and circumstances:

- a) Effect of any natural element or other acts of God, including but not limited to storm, flood, earthquake, lightning, cyclone, landslides or other natural disasters, and
- b) Explosions or fires
- c) Declaration of the Site as war zone.
- d) Any order, regulation, directive, requirement from any Governmental, legislative, executive or judicial authority.

#### 29.3 Notice of Events of Force Majeure

If a force majeure event prevents a party from performing any obligations under the Contract in part or in full, that party shall:

- (i) Immediately notify the other party in writing of the force majeure events within 2 working days of the occurrence of the force majeure event
- (ii) Be entitled to suspend performance of the obligation under the Contract which is affected by force majeure event for the duration of the force majeure event
- (iii) Use all reasonable efforts to resume full performance of the obligation as soon as practicable
- (iv) Keep the other party informed of all such efforts to resume full performance of the obligation on a regular basis
- (v) Provide prompt notice of the resumption of full performance or obligation to the other party.

#### 29.4 Mitigation of events of force majeure:

The Bidder shall:

- (i) Make all reasonable efforts to prevent and reduce to a minimum and mitigate the effect of any delay occasioned by an Event of Force Majeure, including applying other ways in which to perform the Contract;
- (ii) Use its best efforts to ensure resumption of normal performance after the termination of any Event of Force Majeure and shall perform its obligations to the maximum extent practicable as agreed between the Parties; and Keep the Company informed at regular intervals of the circumstances concerning the event of Force Majeure, with best estimates as to its likely continuation and what measures or contingency planning it is taking to mitigate and or terminate the Event of Force Majeure.

#### 29.5 Burden of proof:

In the event that the Parties are unable in good faith to agree that a Force Majeure event has occurred to an affected party, the parties shall resolve their dispute in accordance with the provisions of this Contract. The burden of proof as to

whether or not a force majeure event has occurred shall be upon the party claiming that the force majeure event has occurred and that it is the affected party.

#### 29.6 Terminations for certain events of force majeure:

If any obligation of any Party under the Contract is or is reasonably expected to be delayed or prevented by a Force Majeure event for a continuous period of more than 1 (one) month during the Term of the Contract the Contract shall be terminated at the discretion of the Company and neither Party shall be liable to the other for any consequences arising on account of such termination.

### **30. SECRECY CLAUSE:**

The technical information, drawing and other related documents forming part of work order and the information obtained during the course of investigation under this work order shall be the Company's executive property and shall not be used for any other purpose except for the execution of the work order. The technical information drawing, records and other document shall not be copied, transferred, or divulged and/ or disclosed to third party in full/part, not misused in any form whatsoever except to the extent for the execution of this work order.

This technical information, drawing and other related documents shall be returned to the Company with all approved copies and duplicates including drawing/plans as are prepared by the Bidder during the executions of this work order, if any, immediately after they have been used for agreed purpose.

In the event of any breach of this provision, the Bidder shall indemnify the Company against any loss, cost or damage or claim by any party in respect of such breach.

### **31. TERMINATION**

"During the course of the execution, if at any time BRPL observe and form an opinion that the work under the order is not being performed in accordance with the terms of this Agreement, BRPL reserves its right to cancel this Agreement giving 15 days notice mentioning the reason for the termination of the agreement and BRPL will recover all damages including losses occurred due to loss of time from Bidder.

### **32. QUALITY**

Bidder shall ensure that strict quality is maintained and execution of works under the Work Order and Works are executed in conformity with the Specification.

All tools, tackles, instruments and other equipments used in the execution of the Works shall be duly calibrated as required and Bidder shall maintain proper records of such tools, tackles, instruments and / or equipment.

### **33. LIABILITY OF BIDDERS**

Subject to the due discharge of its obligations under the Contract and except in case of gross negligence or willful misconduct on the part of the Bidder or on the part of any person acting on behalf of the Bidder, with respect to any loss or damage caused by the Bidder to the Employer's property or the Site, the Bidders shall not be liable to the Employer for the following:

- a) For any indirect or consequential loss or damage; and
- b) For any direct loss or damage that exceeds:
  - (i) The total payments made and expected to be made to the Bidder under the Contract including reimbursements, if any; or
  - (ii) The insurance claim proceeds which the Bidder may be entitled to receive from any insurance purchased by the Bidder to cover such a liability, whichever is higher.



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This limitation of liability shall not affect the Bidder's liability, if any, for damage to any third party, caused by the Bidder or any Person or firm acting on behalf of the Bidder in executing the Works.

Notwithstanding anything contained in the Contract, the Bidder shall not be liable for any gross negligence or willful misconduct on the part of the Employer or any of its affiliates, any Bidder, or any party, other than Bidder and/or, its directors, officers, agents or representatives or its affiliates, or Sub-vendor, or the Bidder or any third party engaged by it.

Notwithstanding anything contained in the Contract, including but not limited to approval by the Employer of any drawings, documents, Bidder list, supply of information or data or the participation of the Employer in any meeting and/or discussion or otherwise, shall not absolve the Bidder from any of its liabilities or responsibilities arising in relation to or under the Contract.

**SECTION VII****PRICE FORMAT – ERECTION, TESTING & COMMISSIONING****66/11kV Bakkarwal AIS with 2 PTR**

<b>S.No.</b>	<b>Item Description</b>	<b>Quantity</b>	<b>UOM</b>	<b>Basic (Rs)</b>	<b>GST (Rs)</b>	<b>Unit Landed (Rs)</b>	<b>Total Landed Cost (Rs)</b>
1	ETC of 66/11KV 31.5 MVA Power Transformer including NIFPS	2	Set				
2	Installation of AL Pipe bus bar	1	Lot				
3	ETC of 66kV 3 pole SF6 Circuit Breaker along with support structure (As per Tender SLD)-Including Power Cable Termination	8	Nos				
4	ETC of 66kV CVT (As per Tender SLD)	12	Nos				
5	ETC of 66kV CT (As per Tender SLD)	24	Nos				
6	ETC of 66kV Bus PT(As per Tender SLD)	6	Nos				
7	ETC of Horizontally Rotating double break motorized isolators with one earth switch	16	Nos				
8	ETC of Horizontally rotating double break motorized isolator with 2 earth switch	2	Nos				
9	ETC of Horizontally rotating double break motorized Tendem isolator without earth switch	7	Nos				
10	ETC of Bay Marshaling Kiosk	8	Nos				
11	Fabrication and Installation of Galvanized lattice type switchyard structure tower and Girder	1	Lot				
12	Installation of String bus with twin zebra ACSR conductor for bus coupler and jumpering	1	Lot				
13	Installation of Double and single suspension tension string hardware assembly for Quard Zebra	1	Lot				
14	Fabrication and Installation of Support Structure for all equipments including Bus Post Insulators	1	Lot				
15	ETC of Station Aux Transformer 11/0.433kV 400kVA	1	Nos				
16	ETC OF 66kV Control Relay Panel						
16a	66kV Control Relay Panel Line Feeder	4	Nos				
16b	66kV Control Relay Panel Transformer Feeder	3	Nos				
16c	66kV Control Relay Panel Bus coupler Feeder	1	Nos				
17	ETC OF 220V Li-Ion Battery bank	1	Lot				
18	ETC OF DCDB with battery charger	1	Nos				
19	ETC OF ACDB	1	Nos				
20	ETC OF 11kV APFC 4 Stage, 7.2 MVAR capacitor bank with motorized isolator	2	Sets				

21	ETC OF 11kV APFC 2 Stage, 3.6 MVAR capacitor bank with motorized isolator	2	Sets				
22	ETC of 66kV single phase gapless metal oxide surge arrester	21	Nos				
23	ETC of 66kV Bus Post Insulator	1	Lot				
24	ETC of Cable Mounting Structure	4	Set				
25	ETC of LA Mounting Structure	21	Nos				
26	ETC OF SCADA RTU	1	Set				
27	ETC OF 11kV VCB switchgear with numerical protective relays(as per SLD)						
a	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Incoming	4	Set				
b	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Buscoupler	2	Set				
c	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- outgoing	30	Set				
d	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Capacitor (7.2 MVAR)	2	Set				
e	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Capacitor (3.6 MVAR)	2	Set				
f	11kV VCB switchgear with numerical protective relays(as per Tender SLD)- Station Transformer	1	Set				
g	11kV VCB switchgear Bus PT with riser with numerical protective relays(as per SLD)	2	Set				
h	11kV VCB switchgear Bus PT Panel with numerical protective relays(as per SLD)	2	Set				
i	ETC of Earthing trucks for 11kV Panels- Bus Earthing Truck	2	Set				
j	ETC of Earthing trucks for 11kV Panels- Cable Earthing Truck	2	Set				
28	ETC of Grounding and earthing of entire substation including earthing of transformer fence and capacitor bank fence	1	Set				
29	ETC of high mast lighting 16M	4	Nos				
30	Installation of Indoor LED lighting system including emergency lighting	1	Lot				
31	Installation of Air conditioning for complete substation building except Toilet and Pantry	1	Lot				
32	Installation of Exhaust and Ventillation for Toilet and Pantry						
33	Installation of Building and outdoor lightning protection system	1	Lot				
34	Laying, testing & termination of Control cables along with lugs & glands						

A	6CX4Sqmm	2000	Mtr				
B	6CX2.5Sqmm	8000	Mtr				
C	10CX2.5Sqmm	8000	Mtr				
35	Laying, testing & termination of LT Power cables along with lugs & glands						
A	2CX10Sqmm	1000	Mtr				
B	4CX10Sqmm	1000	Mtr				
C	4CX300Sqmm	100	Mtr				
D	2CX2.5Sqmm	1200	Mtr				
E	4CX95Sqmm	100	Mtr				
F	1CX16Sqmm	50	Mtr				
36	ITC of 11kV Power cable termination kits along with Glands						
A	11KV 3CX400Sqmm I/D cable termination	14	Nos				
B	11KV 1CX1000Sqmm I/D cable termination	42	Nos				
37	ETC OF Fire detection and alarm system for building	1	Lot				
38	Installation of Spacers, Connectors, C-wedge Connectors and Clamps with 10 % spare as per spec	1	Lot				
39	Installation of Cable trays as per spec	1	Lot				
40	Laying, testing & termination of all Cabling between equipments and RTU including glanding	1	Lot				
41	Installation of Fire Extinguisher as per spec	1	lot				
42	Laying, testing , termination of Outdoor LED Lighting including street lighting with poles as per spec	1	Lot				
43	ETC OF Line current differential relay and accessories for remote location	4	Nos				
44	I/T/C of Video Surveillance system as per spec	1	Set				
45	Installation of Cable entry sealing as per reqmt	1	lot				
46	Installation of Cable Mounting Structure for 11 kV Cables from Transformer including civil work	2	Set				
47	Installation of Fire Suppression System of 11KV Panels	1	lot				
48	ETC OF IT Requirements as per BOQ	1	Lot				
49	ETC of Merging unit for installing process bus including all accessories.	1	Lot				
50	Inspection and Training of BRPL Executives ( As per Specs)	1	Lot				

**BOQ shall be read in conjunction with the Tender Document & General Design Criteria**

**Appendix-II****COMMERCIAL TERMS AND CONDITIONS – E/T/C**

SI No	Item Description	AS PER BRPL	BIDDER'S CONFIRMATION
1	Validity	120 days from the due date of submission or amended due date of submission	
2	Price basis	<b>Firm.</b> Prices shall be inclusive of all taxes & duties.	
3	Payment terms	<p>a) 10% mobilization advance against submission of Advance Bank Guarantee of equivalent amount valid upto completion period/ handing over, whichever is earlier plus 3 months claim period. In case of delay, the BG shall be extended suitably.</p> <p>b) 75% pro-rata of total installation value shall be payable against R/A bills payable within 45 days after installation/erection of material at site duly certified by Engineer in charge.</p> <p>c) 10% pro-rata of total installation value shall be payable against R/A bills payable within 30 days after testing &amp; commissioning of material at site duly certified by Engineer in charge.</p> <p>d) 5% of contract value payable after completion of successful acceptance testing, commissioning and handing over of complete systems duly certified by Engineer in charge, submission of Electrical Inspector Clearance Certificate &amp; submission of Bank Guarantee of 10% of contract value valid up to defect liability period i.e. 24 months from the date of Handing over of entire Installation Plus 3 months towards Claim period.</p>	
4	Completion time	10 months from date of LOI/Order	
5	Defect Liability period	24 months from the date of Handing over of entire Installation.	
6	Liquidated damages	0.5 % of the order value for each week or part there of delay until the actual date of completion up to a maximum deduction of 10% of total order value	
7	Contract Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to completion period/handing over.	
8	Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to Defect Liability Period i.e. 24 months from the date of Handing over of entire Installation plus 3 months towards claim period.	



**SECTION VIII****GENERAL TERMS & CONDITIONS – CIVIL WORKS****1. DEFINITIONS:**

The following terms shall have the meaning hereby assigned to them except where the context otherwise requires:

- a. Company shall mean BSES Rajdhani Power Limited, having its office at BSES Bhawan, Nehru Place, New Delhi – 110019 and shall include its authorized representatives, agents, successors and assigns.
- b. Engineer in Charge (EIC) shall be the person authorized by the Company or from time to time duly appointed by the Company for the purpose of the contract.
- c. Contractor shall mean the successful Bidder / vendor to whom the contract has been awarded.
- d. Sub-Contractor shall mean the persons, firm or company to whom any part of the contract has been sublet by the Contractor with the prior written consent of the Company.
- e. Contract, shall mean and include the general terms and conditions, technical specifications, drawings, priced bill of quantities, schedule of rates and prices, if any, tender, Company's letter of intent, the work order and any correspondence letters concerned to the tender, when completed.
- f. Site, shall mean the actual place in over or under which, permanent works or temporary works is to be executed by the Contractor.
- g. Contract Price shall mean the sum named in the letter of acceptance, subject to such additions thereto and /or deductions there from as may be made under the provisions hereinafter contained.
- h. Specifications shall mean specification referred to in the tender and any modification thereof or addition thereto as may, from time to time be instructed by the Company/ the Structural Consultant.
- i. Approved, shall mean approved in writing by Company including subsequent written confirmation of previous verbal approval and "approval" means approval in writing by Company, including as aforesaid.
- j. Defect Liability Period: Shall mean the period during which the contractor shall remain liable for repair or replacement of any defective part of the work performed under the contract, free of cost.

**2. EXAMINATION OF SITE AND LOCAL CONDITIONS::**

The contractor is deemed to have visited the site of the work under the Tender and ascertained therefore all site conditions and information pertaining to his work. Before submitting the bid, all bidders will at their expenses make or obtain any additional information, investigations, explorations, test and studies and obtain any additional information and data which pertains to the physical conditions at or contiguous to the site or otherwise which may affect cost, progress, performance of the work and which the bidder deems necessary to determine its Bid for performing the work in accordance with the time and other terms and conditions of the tender/contract documents. The company shall not entertain any claim whatsoever arising out of the difficult site/terrain/local conditions, if any.

**3. LANGUAGE AND MEASUREMENT:**

The Tender issued to the contractor by the company and all correspondence and documents relating to the Tender placed on the Contractor shall be written in English language. Metric System shall be followed for all dimension, units etc., the mode of measurement shall be as per IS 1200.

#### **4. SCOPE OF WORK:**

The scope of work shall be civil works of 66/11KV AIS Grid Substation at Bakkarwala, New Delhi, including all statutory clearances & certification from State Electrical Inspector, Municipal corporation department (if required), Fire officer (if required), Horticulture department (if required) and various local bodies like RWA. Schedule of work shall be as mentioned in the Bill of quantity attached herewith.

All the Labor, plant appliance, ladder, scaffoldings, materials, tool, tackles etc are included in contractor's scope of work. Adequate number of engineers, supervisors and skilled and unskilled Labors shall be posted at site. The Contractor shall also make his own arrangement for the accommodation/conveyance requirements for its staff at site.

Company will provide at site the adequate open space for setting up contractor's site store for storing the materials, tools, tackles etc. The entire Contractor's storage will be within the site premises. All the incoming and outgoing materials, equipment, tools, tackles and any other items related to said work shall be entered into the register kept for this purpose and shall be in the custody of Contractor, however company does not hold any responsibility for any loss or damage of Contractor's material etc.

All loading/unloading, of materials at work-site shall be your responsibility. Involvement of Crane/Hydra/Tractor/Trailer for this type of work shall be in your scope.

Adequate weather protection shall be provided by the contractor to keep the materials safe from sun & rain by providing covered storage space as well as using tarpaulins.

Water and Electricity Power shall be arranged by the Contractor at his own. The cost of insurance during loading/unloading of materials/ equipments during its storage and handling/erection at site for installation is included in the contractor's scope and value is including in the above mentioned Tender value. The unit rates mentioned in annexure is inclusive of barricading, watch & ward during execution and no separate charges shall be paid for the same.

#### **5. VALUE OF THE ORDER:**

The rates finalized for this order shall be firm for the entire duration of work carried out by the Contractor under the order and are not subject to any variation and escalation for any reason whatsoever. The rates quoted for each item/work in the BOQ shall be deemed to include and cover all cost, expenses and liabilities to every description and all risk of every kind to be taken in executing, completing and handing over the work to the satisfaction of the Company.

The Contractor shall on his own and at his own expense obtain all necessary permits and permissions to execute the job, including required registrations, agent's etc. to perform its obligation under this Contract and shall indemnify the Company in all related matters.

#### **6. TAXES & DUTIES:**

Prices are inclusive of all taxes, duties, Construction Cess etc. leviable by State or Central Government or local bodies including any duties which may be levied by the Govt. during currency of this order. GST as applicable shall be paid on submission of GST Registration and self declaration on your letter head stating that you have deposited/or will deposit the Tax as per the applicable GST laws.

However, Income Tax as per applicable rate will be deducted from your bills as Tax Deduction at Source (TDS).

The total order value shall remain FIRM within stipulated delivery period and shall not be adjusted on account of any price increase/variations in labour & materials. However Statutory Taxes, duties and Levies imposed by

Competent Authorities by way of fresh notification(s) within the stipulated delivery period shall be borne by BRPL on submission of necessary documents claiming such variation.

**7. TERMS OF PAYMENT:**

Payment shall be made to you as under:

- a) 10% of total civil works value shall be payable as advance against submission of Bank Guarantee of equivalent amount valid up to completion date plus 3 (three) months towards claim period. The advance shall be adjusted against R/A Bills.
- b) 80% pro-rata of total civil works value shall be payable against progressive R/A bills payable within 30 days duly certified by Engineer-In-Charge after completion.
- c) 10% of total civil works value shall be payable after completion against submission of Bank Guarantee of equivalent amount valid up to Defect liability period plus 3 (three) months towards claim period.

The Contractor shall submit the final bill along with duly checked final measurements and completion certificate towards the successful completion of the Contract as certified by the EIC.

Payment of final bill shall not be considered conclusive evidence as to the sufficiency of any work or materials, to which it relates, nor shall it relieve as to the sufficiency of work or materials which it relates, nor shall it relieve the Contractor from his liabilities arising from any defects, which become apparent during the Defects Liability Period.

**8. DEFECT LIABILITY PERIOD:**

The civil works shall be guaranteed against any defect or failure which may arise due to faulty materials, design or workmanship for a period of 24 months from the date of handing over of the substation. In case any defect in the work is observed during the defect liability period, the same shall be rectified by the Contractor at own cost including supply of all materials, labour, equipments and any other appliance in this regards (as per prevailing rates) for the fulfillment of all obligations under the Contract and to the satisfaction of the Company, with in 10 day s from the date of receipt of intimation from BRPL.

Under no circumstances any extra claim in terms of time and cost shall be entertained for such repair/rectification.

**9. SCHEDULE OF COMPLETION AND PERIOD OF MOBILISATION:**

The time schedule for carrying out this work and period for mobilization shall be as under:

9.1 The Contractor shall mobilize their Plants & Equipments, Tools & Tackles, Work Labour Force, project team including Engineering Staff and materials required for execution of work at site for commencement of work immediately on receipt of the order.

9.2 The entire work under this order as indicated in the scope of work shall be carried out and completed within the validity period i.e. 300 days. A detailed L2 Schedule shall be submitted by the contractor within 15 days of WO. The contractor shall plan parallel working (round the clock working) f or completion of work as per schedule and mobilize manpower accordingly .

9.3 Progress Review Meeting between the Contractor and the Engineer In charge shall be held at site at least once in a week. Also the report giving the details of the manpower engaged at site and the details of the major job completion shall be submitted to Engineer In charge.

9.4 The above time schedule must be strictly adhered to and improved upon wherever possible. In the event we find that your work is not progressing in quality or time frame as per above agreed schedule and to our satisfaction, we reserve the right to withdraw the work in whole or in part without further notice and liability of the Company.

9.5 The completion of the work shall have to be certified by Engineer In charge.

9.6 In order to maintain the time schedule, if necessary the Contractor shall carry out the work on all Sunday & Holiday except National Holiday with prior written permission from Engineer-in- Charge.

9.7 Contractor shall arrange any permission like for the Road cutting etc. from the local authorities like DDA, PWD, and DJB. Contractor shall also follow up with local authorities and other connected persons that may be required to carry out the job under this order. All Statutory charges and direct fees except Electrical Inspector Clearance fees shall be borne by BRPL.

## **10. TEST CERTIFICATE & QUALITY ASSURANCE:**

### Quality Assurance Program:

The Contractor before the start of work shall submit for approval a quality assurance program to the EIC indicating measures that he proposes to implement to ensure that the quality of work shall be in accordance with requirements, specifications laid down in the Contract. The Contractor shall strictly adhere to this program and any failure attributable to the Contractor shall attract the penal provisions determined by the EIC.

### Quality of materials and workmanship and tests:

The Contractor shall procure all equipment from genius sources as approved by the Company & as per Company specifications. Cement shall be of grade 43 ordinary port land cement conforming to IS 8112/53 grade O.P.C. conforming to IS 12269, aggregate for cement concrete shall conform to IS 383, reinforcement for cold twisted bars shall conform to IS 1786, the bricks for brick work shall correspond to IS 1077, Structural steel shall conform to relevant IS code, water to be used shall comply with requirement of IS 456. Contractor shall provide all requisite facilities for field tests and laboratory tests shall be carried out in the laboratory having ISO 9001-2000 Certified Testing Lab for which no extra payment shall be made. The Contractor shall maintain mandatory Test Register with Engineer-in-Charge as provided in latest Indian Standard Specifications.

All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Engineer-in-Charge's instructions and shall be subjected from time to time to such tests as the Engineer-in-Charge may direct at the place of manufacture or fabrication or on the site or at such other places as may be specified in the Contract, or at all or any of such places. The Contractor shall provide at no additional cost to the Company 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 EIC.

### Cost of samples and tests:

All samples shall be supplied to Company if required by the Contractor at his own cost. The Contractor shall take approval of the EIC prior to start the work for all samples of materials including mix design of concrete to be

utilized for the works to be executed. The mix design of concrete, testing of reinforcement steel and structural steel shall be carried out by an external agency approved by the Company. The cost of all such tests carried out by the external agencies or consultants shall be borne by the Contractor at his own cost and are deemed to be included in the unit rates quoted in the BOQ.

#### Sampling and Testing Concrete on Site

The Contractor can also have cubes tested in an approved laboratory in lieu of a testing machine at site but at his own cost and with the prior written consent of the Company.

#### Inspection of operations:

The Engineer-in-Charge/QC department or any person authorized by them shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery 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.

#### Examination of work before covering up:

No work shall be covered up or put out of view without the approval of the EIC or his representative and the Contractor shall afford full opportunity to the EIC or his 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 EIC or his representative whenever any such work or foundations is or are ready or about to be ready for examination and the EIC or his representative shall, without unreasonable delay, unless he considers it unnecessary, attend for the purpose of the examining such foundations.

### **11. SUB-CONTRACTING / SUBLETTING:**

CONTRACTOR shall not assign or transfer the whole or any part of this Work Order or any other benefits accruing there from nor shall it subcontract / sublet the whole or any part of the Works without the prior written consent of COMPANY. The Company may approve or reject sub-contractor, which in his opinion do not meet the prerequisite qualifications. The Contractor shall re-submit a fresh name for approval.

In the event the contractor assigns this work order, contractor's assignees shall be bound by the terms and conditions of this work order and shall, if deemed necessary by COMPANY at the time of such assignment, undertake in writing to be so bound by this Work Order. Notwithstanding the subletting / subcontracting of any portion of the works, contractor shall remain wholly responsible for the carrying out, completion and satisfactory execution of Works in all respects in accordance with this Work Order, specification, approved drawings and data sheets.

### **12. INDEMNITY:**

Contractor shall indemnify and save harmless COMPANY against and from any and all liabilities, claims, damages, losses or expenses arising due to or resulting from:

- a) Any breach non-observance or non-performance by contractor or its employees or agents of any of the provisions of this Work Order.
- b) Any act or omission of contractor or its employees or agents.
- c) Any negligence or breach of duty on the part of contractor, its employees or agents including any wrongful use by it or them of any property or goods belonging to or by COMPANY or any other third party at site including adjoining neighbors.

Contractor shall at all times indemnify COMPANY against all liabilities to other persons, including the employees or agents of COMPANY or contractor for bodily injury, damage to property or other loss which may arise out of or in consequence of the execution or completion of Works and against all costs charges and expenses that may be occasioned to COMPANY by the claims of such person.

**13. EVENTS OF DEFAULTS:**

COMPANY may, without prejudice to any of its other rights or remedies under the Work Order or in law, terminate the whole or any part of this Work Order by giving written notice to the Contractor, if in the opinion of COMPANY, contractor has neglected to proceed with the works with due diligence or commits a breach of any of the provisions of this work order including but not limited to any of the following cases:

- a) Failing to complete execution of work within the terms specified in this work order.
- b) Failing to complete works in accordance with the approved schedule of works.
- c) Failing to meet requirements of specifications, drawings, and designs as approved by COMPANY.
- d) Failing to comply with any reasonable instructions or orders issued by COMPANY in connection with the works.
- e) Failing to comply with any of the terms or conditions of this work order.

In the event COMPANY terminates this work order, in whole or in part, on the occurrence of any event of default, COMPANY reserves the right to engage any other subcontractor or agency to complete the work or any part thereof, and in addition to any other right COMPANY may have under this work order or in law including without limitation the right to penalize for delay under clause 17.0 of this tender, the contractor shall be liable to COMPANY for any additional costs that may be incurred by COMPANY for the execution of the Work.

**14. RISK & COST:**

If the Contractor fails to execute the work as per specification / as per the direction of Engineer's In-charge within the scheduled period and even after the extended period, the contract shall get cancel and company reserves the right to get the work executed from any other source at the Risk & Cost of the Contractor. The Extra Expenditure so incurred shall be debited to the Contractor.

**15. ENVIRONMENTAL, HEALTH & SAFETY PLAN:**

Contractor will make ensure that the Environment, Health & Safety (EHS) requirements are clearly understood and faithfully implemented at all levels at site as per instruction of Company. Contractors must comply with these requirements:

- a) Comply with all of the elements of the EHS Plan and any regulations applicable to the work
- b) Comply with the procedures provided in the interests of Environment, Health and Safety
- c) Ensure that all of their employees designated to work are properly trained and competent
- d) Ensure that all plant and equipment they bring on to site has been inspected and serviced in accordance with legal requirement and manufacturer's or suppliers' instructions
- e) Make arrangements to ensure that all employees designated to work on or visit the site present themselves for site induction prior to commencement of work
- f) Provide details of any hazardous substances to be brought onsite
- g) Ensure that a responsible person accompanies any of their visitors to site

All contractors' staffs are accountable for the following:

1. Use the correct tools and equipment for the job and use safety equipment and protective clothing supplied, e.g. helmets, goggles, ear protection, etc. as instructed
2. Keep tools in good condition
3. Report to the Supervisor any unsafe or unhealthy condition or any defects in plant or equipment
4. Develop a concern for safety for themselves and for others
5. Prohibit horseplay
6. Not to operate any item of plant unless they have been specifically trained and are authorized to do so.

#### **16. WORK COMPLETION CERTIFICATION, HANDING OVER.**

The work carried out by the Contractor under this order has to be certified by Engineer In-charge for satisfactory completion of work allotted to the contractor with respect to specifications / Field Quality Procedures as per applicable standards. In case of modification/correction to be carried out, contractor shall carry out the said modifications/correction without additional cost. The Contractor shall remain in close contact with Engineer In-Charge at site to report the general findings of the fieldwork during the initial as well as later stage of the work at site.

If required, field findings and for revision of the method for site work if required. Work Completion Certificate shall be issued by the Engineer In charge within 10 days of satisfactory work completion subject to handing over of clear site i/c removal of Labor accommodation, stores, storage arrangements for water, plants, tackles, scaffoldings, ladders, leveling at site. The Contractor shall give undertaking that all standing dues to Labor have been paid and all the statutory obligations have been met with. Completion certificate has to be submitted with the final bill issued by Engineer-in- Charge.

#### **17. PENALTY AND LIQUIDATED DAMAGES:**

17.1 Penalty: A penalty of 2.5% of bill amount shall be levied in each case of non-compliance of safety practices and site cleanliness.

17.2 Liquidated Damages: In the event of any delay in completion of the work beyond the stipulated time given by in order due to reasons solely attributable to the Contractor, the Contractor shall pay to the Company liquidated damages.

If the Contractor failed to complete the construction of subject work within the time period specified in the order, the Company shall, without prejudice to its other remedies under the contract, deduct liquidated damages a sum equivalent to 0.5 % of the total order value for each week or part there of delay until the actual date of completion up to a maximum deduction of 10% of total order value. The levy payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works on time or from any other part of his obligation and liabilities under the Contract. Once the maximum is reached, the Company reserves the right for termination of contract without any liabilities to the Company.

In the event of an extension of time being granted by the EIC, in writing for the Completion of the works, this clause shall be applicable after the expiry of such an extended period.

Engineer In charge should specifically mention the amount of LD levied on the bill of contractor.

#### **18. SAFETY REGULATIONS:**

18.1 The Contractor shall indemnify the Company from any consequence arising due to contractor's failure in respect to safety compliance.

18.2 First Aid facilities at easily accessible place shall be provided by the Contractor at his own cost as per provisions of Labor act or as advised by the Company wherever works are carried out.

18.3 All critical injuries shall be reported promptly to the Company. The report shall cover type, nature, cause, physician's report and actions for prevention of those types again.

18.4 To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Contractor shall be open to inspection by the Company.

18.5 The cost so incurred by the Contractor in providing for safety standards and requirements as above shall be deemed to be included in the rates quoted for various items under the scope of Contract and no extra amounts shall be payable to the contractor on this account.

18.6 The Contractor shall furnish to the Company within seven days from issue of Work Order whichever is earlier, for approval of Company, the proposed safety program on how it intends to implement the safety procedures and precautions to ensure that the site is accident free.

## **19. SAFETY CODE:**

The Contractor shall ensure adequate safety precautions at site as required under the law of the land and shall be entirely responsible for the complete safety of their workman as well as other workers at site and premises. The contractor shall not deploy any worker below the age of 18 years.

The contractor shall observe the safety requirements as laid down in the contract and in case of sub-contract (only after written approval of company), it shall be the responsibility of main contractor that all safety requirements are followed by the employees and staff of the sub-contractor.

The contractor employing two hundred employees or more, including contract workers, shall have a safety coordinator in order to ensure the implementation of safety requirements of the contract and a contractor with lesser number of employees, including contract workers, shall nominate one of his employees to act as safety coordinator who shall liaise with the safety officer on matters relating to safety and his name shall be displayed on the notice board at a prominent place at the work site.

The contractor shall be responsible for non-compliance of the safety measures, implications, injuries, fatalities and compensation arising out of such situations or incidents.

In case of any accident, the contractor shall immediately submit a statement of the same to the owner and the safety officer, containing the details of the accident, any injury or casualties, extent of property damage and remedial action taken to prevent recurrence and in addition, the contractor shall submit a monthly statement of the accidents to the owner at the end of each month.

## **20. STATUTORY OBLIGATIONS:**

The Contractor shall take all steps as may be necessary to comply with the various applicable laws/rules including the provisions of contract labour (Regulation & Abolition Act) 1970 as amended, minimum wages Act, 1984, Workman Compensation Act, ESI Act, PF Act, Bonus Act and all other applicable laws and rules framed there under including any statutory approval required from the Central/State Govt. Ministry of Labour. Broadly, the compliance shall be as detailed below, but not limited to:

- a) An Electrical license issued by Govt. of Delhi.
- b) PF Code No. and all employees to have PF A/c No. under PF every Act, 1952.
- c) All employees to have a temporary or permanent ESI Card as per ESI Act.



- d) ESI Registration No.
- e) PAN No.
- f) GSTN Registration.
- g) Labour License under Contract Labour Act (R & A) Act 1970

(The Contractor shall provide BRPL Engineer-in-charge a copy of Labour License responsible for execution of the job before start of the work.)

The Contractor must follow:

- a) Third party Insurance Policy before start of work.
- b) To follow Minimum Wages Act prevailing in the state.
- c) Salary / Wages to be distributed in presence of representative of Company's representative not later than 7th of each month.
- d) To maintain Wage- cum - Attendance Register.
- e) To maintain First Aid Box at Site.
- f) Latest P.F. and E.S.I. challans pertaining to the period in which work was undertaken along with a certificate mentioning that P.F. and E.S.I. applicable to all the employees has been deducted and deposited with the Authorities within the time limits specified under the respective Acts.
- g) Workman Compensation Policy. {If applicable}
- h) Labour license before start of work. {If applicable}
- i) Group personnel accident insurance shall have coverage of Rs. 10 Lac (Table C- Death + Permanent Total Disability + Partial permanent Disability due to external accidents).

Before issue of order it would be mandatory for the Contractor to furnish the Company the permanent PF code no, ESI registration, registration under W.C.T Act.

## **21. BOCW ACT:**

BOCW Act applies to every establishment which employs, or had employed on any day of the preceding twelve months, ten or more building workers in any building or other construction work . The Contractor for carrying out any construction work, must get themselves registered with the Registering Officer under Section 7 of the Building and Other Construction Workers Act, 1996 and rules made thereto by the concerned State Govt .and submit certificate of Registration, issued from the Registering Officer of the concerned State Govt. (Labour Dept.). As per this Act, the Contractor shall be levied a cess @1% of cost of construction work, which would be deducted from each bill. Cost of material, when supplied under a separate schedule item, shall be outside the purview of cess. The Contractor shall also comply with all provisions of the said Act applicable to him.

## **22. WORKMAN COMPENSATION:**

The Contactor shall take insurance policy under the Workman Compensation Act to cover such workers who are not covered under ESI and PF by the Contractor however engaged to undertake the jobs covered under this order and a copy of this insurance policy will be given to Company for reference and records. This insurance policy shall be kept valid at all times. In case there are no worker involved other than those who are covered under ESI and PF by the Contractor, the Contractor shall certify for the same.

The contractor shall keep the company indemnified at all times, against all claims of compensation under the provision of Workmen Compensation Act 1923 and as amended from time to time or any compensation payable under any other law for the time being workman engaged by the contractor/sub-contractor/sub-agent in carrying out the job involved under this work order and against costs and expenses, if any, incurred by the company in connection therewith and without prejudice to make any recovery.

The company shall be entitled to deduct from any money due to or to become due to the Contractor, moneys paid or payable by way of compensation as aforesaid or cost or expenses in connection with any claims thereto and the Contractor shall abide by the decision of the Company as to the sum payable by the Contractor under the provisions of this clause.

## **23. INSURANCE**

### **a) THIRD PARTY INSURANCE**

Before commencing the execution of the work the contractor shall take third party insurance policy at his own cost to insure against any damage or loss or injury which may occur to any property/public property or to any person or any employee or representative of any outside Agency / the company engaged or not engaged for the work of the company, by or arising out of the execution of the work or temporary work or in carrying out of this Agreement. For third party insurance policies, the contractor shall be responsible for settlement of claims with the underwriters without any liability on the purchaser / owner and will arrange replacements / rectification expeditiously without awaiting settlement by insurance claim at contractors own cost.

### **b) ACCIDENTAL INSURANCE POLICY FOR LIFE COVER:**

Before commencing the execution of the work, the CONTRACTOR shall take Accidental insurance policy for the staff engaged by him for this work to insure against any loss of life which may occur during the contract for the work of the COMPANY. The policy shall have coverage of Rs. 10 Lacs (Table C- Death + Permanent Total Disability + Partial permanent Disability due to external accidents). The Contractor shall be responsible for on the spot same day claim settlement with the victim's legal heirs without waiting for settlement by insurance claim without any liability on BRPL. The premium amount for such life cover policy shall be borne by the contractor. The contractor shall furnish copy of policy when demanded by BRPL.

### **c) INSURANCE FOR MAN, MATERIAL & MACHINERY DEPLOYED AT SITE**

Contractor shall be responsible for the insurance for his own man, material and machinery deployed at site for the package awarded. Contractor shall furnish the copy of this insurance policy to the purchaser, prior start of work.

## **24. ARBITRATION:**

To the best of their ability, the parties hereto shall endeavor to resolve amicably between themselves all disputes arising in connection with this LOA. If the same remain unresolved within thirty (30) days of the matter being raised by either party, either party may refer the dispute for settlement by arbitration. The arbitration is to be undertaken by two arbitrators, one each to be appointed by either party. The arbitrators appointed by both the parties shall mutually nominate a person to act as presiding arbitrator before entering upon the reference in the event of a difference between the two arbitrators and the award of the said presiding arbitrator in such a contingency shall be conducted in accordance with this provisions of the Indian Arbitration & Conciliation Act, 1996 and the venue of such arbitration shall be in the city of New Delhi only.

## **25. Performance Guarantee:**

Bank guarantee shall be drawn in favour of "BSES Rajdhani Power Ltd" as applicable. The performance Bank guarantee shall be in the format as specified by BRPL.

Contract performance bank guarantee of total 10% of the contract price shall be submitted for due performance of this Contract within 15 days of award of contract with the validity till completion of the contract period. The same shall be released after completion of the job

Contractor shall submit the performance bank guarantee equivalent to the 10% of the contract value at the time of claiming the last payment with the validity of the bank guarantee till Defect Liability Period i.e. 24 months from the date of Handing over of entire Installation plus 3 months.

The Company shall reserve the right to invoke the performance bond unconditionally and without recourse to the Contractor, if there is failure to perform any part of the Contract for whatsoever reason. This clause is pertaining to performance of contractual obligations and the decision of Company shall be final in this regard.

In the event, in Company's sole judgment, if the Contractor has fulfilled all its obligations under this Contract, Company shall release the performance bank guarantee without interest, within seven (7) days from the last date up to which the performance bank guarantee is to be kept valid or if it is assessed by the Company that Contractor has not fulfilled its obligation, then the performance bank guarantee shall be extended by the Contractor till that period as requested by the Company.

## **26. GENERAL CONDITIONS:**

- 26.1) No idle labour charges will be admissible in the event of any suspension of work by the Company or stoppage caused in the work due to any other reason resulting in contractors' labour or equipments being rendered idle at any time during the duration of contract.
- 26.2) In the event of any ambiguity, the work order shall supersede LOI & all other correspondence and conditions of contract if furnished earlier.
- 26.3) If the Contractor needs to carry out any work or rework due to change in drawings or structural consultants instructions, the Contractor shall take the prior permission of the Company/ EIC before commencing such works. The Contractors quoted price shall include such rework or incidentals due to quantity variation, or methodology to carry out the works, wherever required and shall not be entitled for any extra payment or extension of time.
- 26.4) The Company reserves the right to claim and recover from the security deposit the damages/ losses incurred due to non-compliance to work, delay in the progress of work by the Contractor as agreed upon. The decision of the Company in this regard shall be final and binding.
- 26.5) The Contractor agrees to abide by other terms and conditions stipulated by the Company from time to time in addition to the above for the proper and satisfactory performance of their obligations under this Contract.

## **27. STAFF AND WORKMAN**

It shall be responsibility of contractor

(a) To obtain Contract Labour License from the concerned authorities and maintain proper liaison with them. Necessary Forms for obtaining Labour License would be issued by the company. However you will bear all expenses for obtaining Labour license and registration in PF Department for your scope of work. You will deposit PF of your staff/laborer each month and all related documents should be furnished to us.

b) To obtain workman insurance cover against deployment of workers etc.

(II) To maintain, proper records relating to workmen employed, in the form of various Registers, namely,

- a) Register of workmen.
- b) Register of muster roll.
- c) Register of overtime.
- d) Register of wages.
- e) Any other register as per latest amendment Labour Act.

The records shall be in the prescribed formats only.

(III) To disburse monthly wages to your workers/ supervisors in time and in the presence of Company representatives or as directed by the Labour authorities.

(IV) To maintain proper liaison with the Project authorities, local police and all other government and local bodies.

(V) To pay your workmen at least not less than the minimum prescribed wages as per state/Central Labour laws as may be, applicable. The contractor shall, be responsible for compliance of all the provisions of minimum Wages Act, PF, ESIC Act workmen Compensation Act and Contract Labour Regulation & Abolition Act the rules made there under. In case of non- compliance of the statutory requirements. the company would take necessary action at the risk and cost of the Contractor.

(VI) To employ required number of skilled/semi-skilled and unskilled workmen as per site requirement to complete the entire project as per schedule. To provide safety shoes, safety helmets, safety belts, gloves etc. to your worker/staff as per requirement during erection work.

(VII) To employ necessary engineering and supervisory staff for completion of the Project in time. While day-to-day management of the site and supervision of the works shall be the responsibility of your Engineer - In charge, he will report to the Engineer in charge to assist him to discharge the overall responsibility of the execution of the project.

## **28. POLLUTION CONTROL:**

All debris shall be removed and disposed of at assigned areas on daily basis. Surplus excavated earth shall be disposed of in an approved manner. In short, the contractor shall be fully responsible for keeping the work site clean at all times. In case of non- compliance, company shall get the same done at Contractor's risk and costs.

All BRPL vendors and execution engineers are hereby advice to adhere below mentioned guidelines while carrying out any civil work including road/ pit digging, plinth/ fence making, road restoration etc.

- I. No construction material/ debris shall be stored on metalled road.
- II. Wind breakers of appropriate height on all sides of ear marked area using CGI sheets shall be raised to ensure that no construction material dust fly outside ear marked area.
- III. The construction material i.e. coarse sand, stone aggregates, excavated earth, cement and any other material to and from the site shall be transported under wet and covered condition to ensure their non-slippage en-route to avoid air contamination.
- IV. The contractor shall provide mask and helmet to every worker working on the construction site and involved in loading/unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
- V. Over loading of vehicles shall be strictly prohibited
- VI. The construction material at site shall be stored under wet and covered condition.  
The dumping sites for temporarily storing the excavated earth shall be properly leveled, watered and rehabilitated by plantation to avoid flying of dust.
- VII. The worker at the site shall be sensitized to adopt / observe the dust controlled measures in true spirit.

- VIII. If any C&D waste is generated at site the same will be transported to the C&D waste site only and the record for the same will be maintained by the agency.
- IX. Wet jet in grinding and stone cutting is being permitted at site.
- X. The necessary record for dust control is being maintained by the department on day to day basis and being monitored regularly.  
The Contractor shall be responsible for all the preventive and protective environmental steps as per guidelines. Execution in- charge has to ensure all vendors comply with these instructions. Any violations from the above guidelines have been viewed very seriously by the authorities. Concerned agency is liable for the penalties / other action by the authorities, The Agency shall indemnify BRPL from all liabilities on this account.

**29. FORCE MAJEURE:**

## 29.1 General:

An "Event of Force Majeure" shall mean any event or circumstance not within the reasonable control, of the Party affected, but only if and to the extent that:

(i) Such event or circumstance, despite the exercise of reasonable diligence, could not have been prevented, avoided or reasonably foreseen by such Party;

(ii) Such event or circumstance materially and adversely affects the ability of the affected Party to perform its obligations under this Contract, and the affected Party has taken all reasonable precautions, due care and reasonable alternative measures in order to prevent or avoid the effect of such event on the affected parties ability to perform its obligations under this Contract and to mitigate the consequences thereof. For the avoidance of doubt, if such event or circumstance would not have materially and adversely affected the performance of the affected party had such affected party followed good industry practice, such event or circumstance shall not constitute force majeure.

(iii) Such event is not the direct or indirect result of the failure of such Party to perform any of its obligations under this Contract; and

(iv) Such Party has given the other Party prompt notice describing such events, the effect thereof and the actions being taken in order to comply with above clause

## 29.2 Specific Events of Force Majeure:

Subject to the provisions of above clause, Events of Force Majeure shall include only the following to the extent that they or their consequences satisfy the above requirements:

The following events and circumstances:

- e) Effect of any natural element or other acts of God, including but not limited to storm, flood, earthquake, lightning, cyclone, landslides or other natural disasters, and
- f) Explosions or fires
- g) Declaration of the Site as war zone.
- h) Any order, regulation, directive, requirement from any Governmental, legislative, executive or judicial authority.

## 29.3 Notice of Events of Force Majeure

If a force majeure event prevents a party from performing any obligations under the Contract in part or in full, that party shall:

- (i) Immediately notify the other party in writing of the force majeure events within 2 working days of the occurrence of the force majeure event
- (ii) Be entitled to suspend performance of the obligation under the Contract which is affected by force majeure event for the duration of the force majeure event
- (iii) Use all reasonable efforts to resume full performance of the obligation as soon as practicable
- (iv) Keep the other party informed of all such efforts to resume full performance of the obligation on a regular basis
- (v) Provide prompt notice of the resumption of full performance or obligation to the other party.

#### 29.4 Mitigation of events of force majeure:

The Contractor shall:

- (i) Make all reasonable efforts to prevent and reduce to a minimum and mitigate the effect of any delay occasioned by an Event of Force Majeure, including applying other ways in which to perform the Contract;
- (ii) Use its best efforts to ensure resumption of normal performance after the termination of any Event of Force Majeure and shall perform its obligations to the maximum extent practicable as agreed between the Parties; and Keep the Company informed at regular intervals of the circumstances concerning the event of Force Majeure, with best estimates as to its likely continuation and what measures or contingency planning it is taking to mitigate and or terminate the Event of Force Majeure.

#### 29.5 Burden of proof:

In the event that the Parties are unable in good faith to agree that a Force Majeure event has occurred to an affected party, the parties shall resolve their dispute in accordance with the provisions of this Contract. The burden of proof as to whether or not a force majeure event has occurred shall be upon the party claiming that the force majeure event has occurred and that it is the affected party.

#### 29.6 Terminations for certain events of force majeure:

If any obligation of any Party under the Contract is or is reasonably expected to be delayed or prevented by a Force Majeure event for a continuous period of more than 1 (one) month during the Term of the Contract the Contract shall be terminated at the discretion of the Company and neither Party shall be liable to the other for any consequences arising on account of such termination.

### **30. SECURITY CLAUSE:**

The Contractor shall not communicate or use in advertising, publicity, sales release or in any medium photograph or reproduction of the works under this contract, or description of the site, dimensions, quantity or any other information concerning the works unless prior written permission is obtained from Company. The Contractor shall keep all the information obtained directly or indirectly through appointment of this contract confidential and shall not reveal the same to any other party without the prior written permission of the Company.

The technical information, drawing and other related documents forming part of work order and the information obtained during the course of investigation under this work order shall be the Company's executive property and shall not be used for any other purpose except for the execution of the work order. The technical information

drawing, records and other document shall not be copied, transferred, or divulged and/ or disclosed to third party in full/part, not misused in any form whatsoever except to the extent for the execution of this work order.

This technical information, drawing and other related documents shall be returned to the Company with all approved copies and duplicates including drawing/plans as are prepared by the Contractor during the executions of this work order, if any, immediately after they have been used for agreed purpose.

In the event of any breach of this provision, the contractor shall indemnify the Company against any loss, cost or damage or claim by any party in respect of such breach.

### **31. APPROACHES:**

The Contractor shall have to make his own arrangements for all approaches to the site required for transporting his men and material to site of work. The Company shall entertain no payment or claims on account of "Making of Approaches".

### **32. SITE LOCATION:**

The Contractor must see the site of the work, surrounding locality, local traffic rules, site approaches etc. carefully. No claim of any sort shall be entertained on account of any site conditions. If any approach from main road is required or existing approach is to be improved and maintained, for cartage of materials by the contractor, the same shall be provided, improved and maintained by him at his own cost.

### **33. CO-ORDINATION WITH OTHER AGENCIES:**

The Contractor shall execute the work in strict consultation with the Company and in co-ordination with other agencies appointed by the Company who will also simultaneously execute the components of work allotted to them.

The Contractor at his own cost shall also extend their site facilities, plant and equipments on written request of the Company/ EIC for use by other contractors appointed by the Company

### **34. TERMINATION OF CONTRACT:**

If in case the Contractor;

- a) becomes bankrupt or insolvent, has a receiving order issued against it compounds with its creditors, or if the Contractor is a corporation a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction) a receiver is appointed over any part of its undertaking or assets or if the Contractor takes or suffers any other analogous action in consequence of debt.
- b) Assigns or transfers the Contract or any right or interest therein in violation of the provision of given work to sub-contractor.
- c) In the judgment of the Company, has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this Sub-clause

"Corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in Contract execution.

"Fraudulent practice" means misrepresentation of facts in order to influence a procurement process or the execution of a Contract detriment to Company and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Purchaser of the benefits of free and open competition.

- a) Has abandoned or repudiated the Contract
- b) Has without valid reason failed to commence work on the Facilities promptly or has suspended days after receiving a written instruction from the Company to proceed.
- c) Persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause.
- d) Refuses or is unable to provide sufficient materials, services or labour to execute and complete the Facilities in the manner specified in the program furnished and at rate of progress that give reasonable assurance to the Company that the Contractor can attain completion of the Facilities by the time for completion.

The Company may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) days of its receipt of such notice the Company may terminate the Contract forthwith by giving a notice of termination to the Contractor.

In case, Contractor fails to carry out the work as specified in the schedule or left in between, it will be got done through any other agency at contractors' risk and cost, the same shall be recovered from the amount payable to the Contractor.

In case the Contractor fails to start work / to carry out the work within the specified period i.e. mutually agreed schedule and the work is not found to be satisfactory, the Company reserves the right to terminate the contract, at any stage without assigning any reasons thereof. In such case, the Company shall have the right to forfeit the entire / part amount of EMD / Security Deposit.

### **35. LIABILITY OF CONTRACTORS**

Subject to the due discharge of its obligations under the Contract and except in case of gross negligence or willful misconduct on the part of the Contractor or on the part of any person acting on behalf of the Contractor, with respect to any loss or damage caused by the Contractor to the Employer's property or the Site, the Contractors shall not be liable to the Employer for the following:

- a) For any indirect or consequential loss or damage; and
- b) For any direct loss or damage that exceeds:
  - (i) The total payments made and expected to be made to the Contractor under the Contract including reimbursements, if any; or
  - (ii) The insurance claim proceeds which the Contractor may be entitled to receive from any insurance purchased by the Contractor to cover such a liability, whichever is higher.

This limitation of liability shall not affect the Contractor's liability, if any, for damage to any third party, caused by the Contractor or any Person or firm acting on behalf of the Contractor in executing the Works.

Notwithstanding anything contained in the Contract, the Contractor shall not be liable for any gross negligence or willful misconduct on the part of the Employer or any of its affiliates, any Contractor, or any party, other than Contractor and/or, its directors, officers, agents or representatives or its affiliates, or Subcontractor, or the Contractor or any third party engaged by it.

Notwithstanding anything contained in the Contract, including but not limited to approval by the Employer of any drawings, documents, Contractor list, supply of information or data or the participation of the Employer in any meeting and/or discussion or otherwise, shall not absolve the Contractor from any of its liabilities or responsibilities arising in relation to or under the Contract.



**SECTION IX****Price format- Civil**

Civil BOQ (Bakkarwala)							
SL.No	Description	Qty	Unit	Basic Rate (Rs.)	GST in Rs	Landed rate in Rs	Total Amount
1	Complete Design & Engineering of Grid Substation. The building foundation shall be designed for Ground floor + 1 Floor Future Planning, including survey of plot, if required.	1.00	LS				
2	Detailed engineering of Substation building with equipments on ground floor. RCC staircase for approach to roof as per layout and specification. In case of increase in length/width of building due to equipment dimension, the same shall be in scope of Vendor. No additional cost will be given. (Payment break up for Running Bill shall be as follows for this item only.) i) up to DPC -20% ii) Lintel and brick work upto GF (Ground floor) roof slab -10% iii) Roof casting ground floor & Mumty with water proofing- 15% iv) Internal/ external finishing and terrace - 15% v) Indoor trenches including supporting hangers & chequered plate- 10% vi) Flooring/painting/water supply & sanitary system- 15% vii) Doors, windows, staircase railing, etc- 5% viii) Final completion - 10%	1.00	Set				
3	All Outdoor Infeed, Control & Power cable trenches with trench covers (RCC slab or RCC cover), supporting hangers, etc as per specification and system requirement.	1.00	Lot				
4	Power transformer foundations with oil collection chamber all around & P/F MS grating over oil collection chamber as per specification.	3.00	Nos				

5	A) Fire wall between transformers/ as per layout/ as per approved drawing.	1.00	Nos				
	B) BOT and pipe connection for Burnt Oil tank as per approved drawing.	2.00	Lot				
6	A) RCC road inside substation as per layout and specification.	1.00	LS				
	B) Balance areas not covered by building, switchyard and road shall be Cement Concrete / Paver blocks as per approved drawing.	1.00	LS				
7	A)Outdoor Switchyard development (as per approved layout/ specification)	1.00	Lot				
	B) Landscaping & Green belt development as per approved layout (including P/L GI/PVC pipes with hydrants at suitable intervals/locations for post maintenance of green belt).	1.00	Lot				
8	Underground water tank with electrical (Booster) pump of sufficient capacity and one outlet and hose, etc.	1.00	Set				
9	Rain water drainage arrangement within and outside switchyard, Rain water harvesting system (as per approved drawing based on CGWB guidelines) & arrangement for drinking water, sanitary system , etc.	1.00	Lot				
10	Equipment foundation, Gantry/ tower foundation, Capacitor bank foundation, Auxiliary/ local transformer foundation, foundation of lighting poles (high mast, street pole, etc), BPI foundation, etc. and construction of brick steps with cement plaster for smooth operation of circuit breakers, etc.	1.00	Lot				
11	Fencing with gate of Switchyard, Capacitor bank, Auxiliary/local transformer, etc as per approved drawing.	1.00	Lot				
12	Foundation & Oil tank for NIFPS equipment.	1.00	LS				

13	Supply of good earth (or other approved filling material) including filling in trenches, plinth, road, sides of foundations & in open areas upto required formation level in layers not exceeding 20 cm in depth, consolidating each deposited layer by raming & watering complete.	1.00	LS				
14	Construction of permanent Security Gumtee (approx. 9 SQM area) is to be made as per standard approved drawing.	1.00	LS				
<b>Total</b>							
<b>Note:</b>	For detail description, kindly refer Technical Specification for Civil Work						

**Appendix-III****COMMERCIAL TERMS AND CONDITIONS – Civil**

SI No	Item Description	AS PER BRPL	BIDDER'S CONFIRMATION
1	Validity	120 days from the due date of submission or amended due date of submission	
2	Price basis	<b>Firm.</b> Prices shall be inclusive of all taxes & duties.	
3	Payment terms	<p>a) 10% of total civil works value shall be payable as advance against submission of Bank Guarantee of equivalent amount valid up to completion date plus 3 (three) months towards claim period. The advance shall be adjusted against R/A Bills.</p> <p>b) 80% pro-rata of total civil works value shall be payable against progressive R/A bills payable within 30 days duly certified by Engineer-In-Charge after completion.</p> <p>c) 10% of total civil works value shall be payable after completion against submission of Bank Guarantee of equivalent amount valid upto Defect liability period plus 3 (three) months towards claim period.</p>	
4	Completion time	10 months from date of LOI/Order	
5	Defect Liability period	24 months from the date of Handing over of entire Installation.	
6	Liquidated damages	0.5 % of the order value for each week or part there of delay until the actual date of completion up to a maximum deduction of 10% of total order value	
7	Contract Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to completion period/handing over.	
8	Performance Bank Guarantee	10% (Ten percent) of the Contract Price valid up to Defect Liability Period i.e. 24 months from the date of Handing over of entire Installation plus 3 months towards claim period.	

**SECTION X****GRAND SUMMARY OF THE QUOTED PRICE**

Sr. Nos.	SCHEME DESCRIPTION	Total price for supply F.O.R site inclusive all duties taxes	Total for Erection, Testing & Commissioning inclusive all Taxes(INR)	Total for Civil Works inclusive all Taxes(INR)	Grand Total(INR)
1	Survey, Design, Supply, Installation, Testing and Commissioning including Civil Works of 66/11 kV AIS Grid substation with 2 PTRs on Single point responsibility basis at Bakkarwala				
<b>TOTAL Package Cost</b>					
<b>In words :</b>					

We declare that the following are our quoted prices in INR for the entire project/schemes.

Date:

Bidder Name:

Place:

Bidders Address:

Name &amp; Signature .....

Designation: .....

Common Seal:.....



BSES RAJDHANI POWER LIMITED

**APPENDIX IV**

**BID FORM**

To

Head of Department  
Contracts & Material Deptt.  
BSES Rajdhani Power Ltd  
New Delhi 110019

Sir,

1 We understand that BRPL is desirous of execution of  
.....(Name of work)

2 Having examined the Bidding Documents for the above named works, we the undersigned, offer to deliver the goods in full conformity with the Terms and Conditions and technical specifications for the sum indicated in Price Bid or such other sums as may be determined in accordance with the terms and conditions of the contract .The above amounts are in accordance with the Price Schedules attached herewith and are made part of this bid.

3 If our Bid is accepted, we undertake to deliver the entire goods as) as per delivery schedule mentioned in Section IV from the date of award of purchase order/letter of intent.

4 If our Bid is accepted, we will furnish a performance bank guarantee for an amount of 10% (Ten)percent of the total contract value for due performance of the Contract in accordance with the Terms and Conditions.

5 We agree to abide by this Bid for a period of 120 days from the due date of bid submission & subsequent corrigendum/amendment/extension of due date of submission. It shall remain binding upon us and may be accepted at any time before the expiration of that period.

6 We declare that we have studied the provision of Indian Laws for supply of equipments/materials and the prices have been quoted accordingly.

7 Unless and until Letter of Intent is issued, this Bid, together with your written acceptance there of, shall constitute a binding contract between us.

8 We understand that you are not bound to accept the lowest, or any bid you may receive.

9 There is provision for Resolution of Disputes under this Contract, in accordance with the Laws and Jurisdiction of Contract.

Dated this..... day of..... 20.....

Signature..... In the capacity of

.....duly authorized to sign for

and on behalf of

(IN BLOCK CAPITALS).....

**Appendix V****ACCEPTANCE FORM FOR PARTICIPATION IN REVERSE AUCTION EVENT**

(To be signed & stamped by the bidder along-with bid)

BSES Rajdhani Power Ltd (BRPL) intends to use reverse auction through SAP-SRM tool as an integral part of entire tendering process. All techno-commercially qualified bidders shall participate in the reverse auction.

The following terms and conditions are deemed as accepted by the bidder on participation in the bid:-

1. In case of bidding through Internet medium, bidders are advised to ensure availability of all associated infrastructure as required to participate in the reverse auction event. Inability to bid due to telephone glitch, internet response issues, software & hardware hangs/failures, power failures or any other reason shall not be the responsibility of BRPL.
2. In case bidder fails to participate in the reverse auction event due to any reason whatsoever, it shall be presumed that the bidder has no further discounts to offer and the initial bid submitted by them as a part of tender shall be considered as bidder's Final No Regret offer. Any off-line price bids received from a bidder in lieu of non-participation in the reverse auction event shall be rejected by BRPL.
3. The bidder is advised to understand the auto bid process to safeguard themselves against any possibility of non-participation in the reverse auction event.
4. The bidder shall be prepared with competitive price quotes during the day of reverse auction event.
5. The prices quoted by bidder in reverse auction event shall be on FOR Landed cost BRPL Store/site basis inclusive of all relevant taxes, duties, levies, transportation charges etc.
6. The prices submitted by the bidder during reverse auction event shall be binding on the Bidder.
7. The bidder agrees to non-disclosure of trade information regarding bid details e.g. purchase, Identity, bid process/technology, bid documentation etc.
8. BRPL will make every effort to make the bid process transparent. However award decision of BRPL will be final and binding on the bidder.
9. The prices submitted during reverse auction event shall be binding on the bidder.
10. No request for Time extension of the reverse auction event shall be considered by BRPL.
11. BRPL shall provide the user id and password to the authorized representative of the bidder. Authorization letter in lieu of the same shall be submitted along with the signed and stamped acceptance form.
12. The original price bids of the bidders shall be reduced on pro-rata basis against each line item based on the final all inclusive prices offered during conclusion of the reverse auction event for arriving at contract amount

**APPENDIX VI****FORMAT FOR EMD BANK GUARANTEE**

*(To be issued in a Non Judicial Stamp Paper of Rs.50/-purchased in the name of the bank)*

Whereas [*name of the Bidder*] (herein after called the "Bidder") has submitted its bid dated [*date of submission of bid*] for the supply of [*name and/or description of the goods*] (here after called the "Bid").

KNOW ALL PEOPLE by these presents that WE [*name of bank*] at [*Branch Name and address*],having our registered office at[*address of the registered office of the bank*](herein after called the "Bank"),are bound unto BSES Rajdhani Power Ltd., with it's Corporate Office at BSES Bhawan Nehru Place, New Delhi -110019 ,(herein after called —the "Purchaser")in the sum of Rs. ....../- (Rupees ..... only) for which payment well 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\_\_\_\_\_.

THE CONDITIONS of this obligation are:

- 1 If the Bidder withdraws its Bid during the period of bid validity specified by the Bidder on the Bid Form ; or
2. 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 Form, if required; or
  - (b) Fails or refuses to furnish the performance security, In accordance with the Instructions to Bidders/ Terms and Conditions;

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 is its demand the purchaser will note that amount claimed by it is due to it, owing to the occurrence of one or both of the two condition(s), specifying the occurred condition or condition(s).

This guarantee will remain in force up to and including One Hundred Twenty (120) days after the due date of submission bid, and any demand in respect thereof should reach the Bank not later than the above date.

(Stamp & signature of the bank)

Signature of the witness



**APPENDIX - VII****LITIGATION HISTORY**

Year	Name of client	Details of contract & date	Cause of Litigation/ arbitration and dispute	Disputed amount

**APPENDIX - VIII****CURRENT CONTRACT COMMITMENTS/ WORK IN PROGRESS**

Year	Name of client	Details of contract & date	Value of outstanding work	Estimated completion date

**APPENDIX - IX****FINANCIAL DATA**

(Duly Certified by Chartered Accountant)

	FY 18-19	FY 17-18	FY 16-17
Total assets			
Current assets			
Total Liability			
Current Liability			
Profit before taxes			
Profit after taxes			
Sales Turnover			

**APPENDIX X****CHECK LIST**

SI No	Description	Compliance
1	INDEX	YES/NO
2	COVERING LETTER	YES/NO
3	BID FORM (UNPRICED) DULY SIGNED	YES/NO
4	BILL OF MATERIAL (UNPRICED)	YES/NO
5	DOCUMENTS IN SUPPORT OF QUALIFICATION CRITERIA	YES/NO
6	TECHNICAL BID	YES/NO
7	ACCEPTANCE TO COMMERCIAL TERMS AND CONDITIONS	YES/NO
8	FINANCIAL BID (IN SEALED ENVELOPE)	YES/NO
9	EMD IN PRESCRIBED FORMAT	YES/NO
10	DEMAND DRAFT OF RS 1000/- DRAWN IN FAVOUR OF BSES RAJDHANI POWER LTD	YES/NO
11	POWER OF ATTORNEY/AUTHORISATION LETTER FOR SIGNING THE BID	YES/NO
12	FINANCIAL DATA IN TABULAR FORMAT	YES/NO
13	LIST OF CURRENT COMMITMENTS/ WORK IN PROGRESS	YES/NO
14	BANK SOLVENCY CERTIFICATE	YES/NO
15	NO LITIGATION CERTIFICATE	YES/NO

**APPENDIX-XI**  
**FORMAT FOR PERFORMANCE BANK GUARANTEE**

(TO BE ISSUED ON RS 100/- STAMP PAPER)

Bank Guarantee No.

Place:

Date:

To  
BSES Rajdhani Power Limited

Whereas BSES RAJDHANI POWER LTD (hereinafter referred to as the "Purchaser", which expression shall unless repugnant to the context or meaning thereof include its successors, administrators and assigns) has awarded to M/s. \_\_\_\_\_ with its Registered/ Head Office at \_\_\_\_\_

(Hereinafter referred to as the "Supplier" which expression shall unless repugnant to the context or meaning thereof, include its successors administrators, executors and assigns), a contract no. \_\_\_\_\_ Dated \_\_\_\_\_ (the Contract);

And whereas the value of the Contract is Rs. \_\_\_\_\_ (The Contract Value).

And whereas it is a condition of the Contract that the Supplier shall provide a Performance Bank Guarantee for the due and faithful performance of the entire Contract for a sum equivalent to - % of the Contract Value to the Purchaser on or before \_\_\_\_\_

And whereas the Bank under instructions from the Supplier has agreed to guarantee the due performance of the Contract.

Now it is agreed as follows:

1. we \_\_\_\_\_ (Name of the Bank) having its Head Office at \_\_\_\_\_ (hereinafter referred to as the Bank, which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) shall indemnify and keep indemnified the Purchaser for, and guarantee and undertake to pay to the Purchaser immediately on written demand, a sum equivalent to % of the Contract Value as aforesaid at any time upto \_\_\_\_\_ (day/month/year) without any demur, reservation, contest, recourse or protest and/or without any reference to the Supplier, against all losses, damages, costs and expenses that may be caused to or suffered by the Purchaser by reason of any default on the part of the Supplier in performing and observing any and all the terms and conditions of the Contract or breach on the part of the Supplier of terms or conditions of the Contract.
2. The demand shall consist only of an original letter issued by Purchaser stating that the Supplier has failed to fulfill its obligations under the Contract. Such demand made by the Purchaser on the Bank shall be conclusive and binding notwithstanding any difference or dispute between the Purchaser and the Supplier or any difference or dispute pending before any Court, Tribunal, Arbitrator or any other authority.
3. The Bank undertakes not to revoke this guarantee during its currency without previous written consent of the Purchaser and further agrees that the guarantee herein contained shall continue to be enforceable during the period that would be taken for satisfactory performance and fulfillment in all respects of the Contract or in the event of any dispute between the Purchaser and Supplier until the dispute is settled (provided that the claim/ demand under this guarantee is \_\_\_\_\_)



BSES RAJDHANI POWER LIMITED

lodged /referred during the currency of this guarantee) or till the Purchaser discharges this guarantee whichever is earlier.

4. The Purchaser shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee from time to time to extend the time for performance of the Contract by the Supplier. The Purchaser shall have the fullest liberty, without affecting the liability of the Bank under this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Supplier, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract. or any other course or remedy or security available to the Purchaser. The Bank shall not be released of its obligations under these presents by any exercise by the Purchaser of its liberty with reference: to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Purchaser or any other indulgence shown by the Purchaser of by any other matter or thing whatsoever which under law would, but for this provision, have the effect of relieving the Bank.

5. The Bank agrees that the Purchaser and its option shall be entitled to enforce this guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Supplier and notwithstanding any security or other guarantee that the Purchaser may have in relation to the Supplier's liabilities.

6. Notwithstanding anything contained hereinabove the liability of the Bank under this guarantee is restricted to a sum equivalent to % of the Contract Value ie. Rs.(Rupees) and it shall remain in force upto and including .Unless a demand to enforce a claim under this guarantee is made against the Bank within 3 months from the the above date of expiry i.e. up to all the rights of the Purchaser under the said guarantee shall be forfeited and the Bank shall be released and discharged from all liabilities thereafter.

7. This Performance Bank Guarantee shall be governed by the laws of India.

Dated this Witness

day of 20..... at

1. For Bank

2. Signature Name Power of Attorney No:

Banker's Seal

## **SECTION XI**

### **VENDOR CODE OF CONDUCT**

Bidder shall agree to comply with Vendor code of Conduct as mentioned in BRPL Website. Purchaser is committed to conducting its business in an ethical, legal and socially responsible manner. To encourage compliance with all legal requirements and ethical business practices, Purchaser has established this Vendor Code of Conduct (the "Code") for Purchaser's Vendors. For the purposes of this document, "Vendor" means any company, corporation or other entity that sells, or seeks to sell goods or services, to Purchaser, including the Vendor's employees, agents and other representatives. Fundamental to adopting the Code is the understanding that a business, in all of its activities, must operate in full compliance with the laws, rules and regulations of the countries in which it operates. This Code encourages Vendors to go beyond legal compliance, drawing upon internationally recognized standards, in order to advance social and environmental responsibility.

#### **I. Labour and Human Rights**

Vendors must uphold the human rights of workers, and treat them with dignity and respect as understood by the international community.

- Fair Treatment - Vendors must be committed to a workplace free of harassment. Vendors shall not threaten workers with or subject them to harsh or inhumane treatment, including sexual harassment, sexual abuse, corporal punishment, mental coercion, physical coercion, verbal abuse or unreasonable restrictions on entering or exiting company provided facilities.
- Antidiscrimination - Vendors shall not discriminate against any worker based on race, colour, age, gender, sexual orientation, ethnicity, disability, religion, political affiliation, union membership, national origin, or marital status in hiring and employment practices such as applications for employment, promotions, rewards, access to training, job assignments, wages, benefits, discipline, and termination. Vendors shall not require a pregnancy test or discriminate against pregnant workers except where required by applicable laws or regulations or prudent for workplace safety. In addition, Vendors shall not require workers or potential workers to undergo medical tests that could be used in a discriminatory way except where required by applicable law or regulation or prudent for workplace safety.
- Freely Chosen Employment - Forced, bonded or indentured labour or involuntary prison labour is not to be used. All work will be voluntary, and workers should be free to leave upon reasonable notice. Workers shall not be required to hand over government-issued identification, passports or work permits as a condition of employment.
- Prevention of Under Age Labour - Child labour is strictly prohibited. Vendors shall not employ children. The minimum age for employment or work shall be 15 years of age, the minimum age for

employment in that country, or the age for completing compulsory education in that country, whichever is higher. This Code does not prohibit participation in legitimate workplace apprenticeship programs that are consistent with Article 6 of ILO Minimum Age Convention No. 138 or light work consistent with Article 7 of ILO Minimum Age Convention No. 138.

- Juvenile Labour - Vendors may employ juveniles who are older than the applicable legal minimum age for employment but are younger than 18 years of age, provided they do not perform work likely to jeopardize their health, safety, or morals, consistent with ILO Minimum Age Convention No. 138.
- Minimum Wages - Compensation paid to workers shall comply with all applicable wage laws, including those relating to minimum wages, overtime hours and legally mandated benefits. Any disciplinary wage deductions are to conform to local law. The basis on which workers are being paid is to be clearly conveyed to them in a timely manner.
- Working Hours - Studies of good manufacturing practices clearly link worker strain to reduced productivity, increased turnover and increased injury and illness. Work weeks are not to exceed the maximum set by local law. Further, a work week should not be more than 60 hours per week, including overtime, except in emergency or unusual situations. Workers should be allowed at least one day off per seven-day week.
- Freedom of Association - Open communication and direct engagement between workers and management are the most effective ways to resolve workplace and compensation issues. Vendors are to respect the rights of workers to associate freely and to communicate openly with management regarding working conditions without fear of reprisal, intimidation or harassment. Workers' rights to join labour unions, seek representation and or join worker's councils in accordance with local laws should be acknowledged.

- II. Health and Safety Vendors must recognize that in addition to minimizing the incidence of work-related injury and illness, a safe and healthy work environment enhances the quality of products and services, consistency of production and worker retention and morale. Vendors must also recognize that ongoing worker input and education is essential to identifying and solving health and safety issues in the workplace.

The health and safety standards are:

- Occupational Injury and Illness - Procedures and systems are to be in place to prevent, manage, track and report occupational injury and illness, including provisions to: a) encourage worker reporting; b) classify and record injury and illness cases; c) provide necessary medical treatment; d) investigate cases and implement corrective actions to eliminate their causes; and e) facilitate return of workers to work.
- Emergency Preparedness - Emergency situations and events are to be identified and assessed, and their impact minimized by implementing emergency plans and response procedures, including:

emergency reporting, employee notification and evacuation procedures, worker training and drills, appropriate fire detection and suppression equipment, adequate exit facilities and recovery plans.

- Occupational Safety - Worker exposure to potential safety hazards (e.g., electrical and other energy sources, fire, vehicles, and fall hazards) are to be controlled through proper design, engineering and administrative controls, preventative maintenance and safe work procedures (including lockout/tagout), and ongoing safety training. Where hazards cannot be adequately controlled by these means, workers are to be provided with appropriate, well-maintained, personal protective equipment. Workers shall not be disciplined for raising safety concerns.
- Machine Safeguarding - Production and other machinery is to be evaluated for safety hazards. Physical guards, interlocks and barriers are to be provided and properly maintained where machinery presents an injury hazard to workers.
- Industrial Hygiene - Worker exposure to chemical, biological and physical agents is to be identified, evaluated, and controlled. Engineering or administrative controls must be used to control overexposures. When hazards cannot be adequately controlled by such means, worker health is to be protected by appropriate personal protective equipment programs.
- Sanitation, Food, and Housing - Workers are to be provided with ready access to clean toilet facilities, potable water and sanitary food preparation, storage, and eating facilities. Worker dormitories provided by the Participant or a labour agent are to be maintained clean and safe, and provided with appropriate emergency egress, hot water for bathing and showering, and adequate heat and ventilation and reasonable personal space along with reasonable entry and exit privileges.
- Physically Demanding Work - Worker exposure to the hazards of physically demanding tasks, including manual material handling and heavy or repetitive lifting, prolonged standing and highly repetitive or forceful assembly tasks is to be identified, evaluated and controlled.

### III. Environmental

Vendors should recognize that environmental responsibility is integral to producing world class products. In manufacturing operations, adverse effects on the environment and natural resources are to be minimized while safeguarding the health and safety of the public.

The environmental standards are:

- Product Content Restrictions - Vendors are to adhere to applicable laws and regulations regarding prohibition or restriction of specific substances including labeling laws and regulations for recycling and disposal. In addition, Vendors are to adhere to all environmental requirements specified by Purchaser.

- Chemical and Hazardous Materials -Chemical and other materials posing a hazard if released to the environment are to be identified and managed to ensure their safe handling, movement, storage, recycling or reuse and disposal.
- Air Emissions - Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone depleting chemicals and combustion by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge.
- Pollution Prevention and Resource Reduction -Waste of all types, including water and energy, are to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.
- Wastewater and Solid Waste - Wastewater and solid waste generated from operations, industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to discharge or disposal.
- Environmental Permits and Reporting - All required environmental permits (e.g. discharge• monitoring) and registrations are to be obtained, maintained and kept current and their operational and reporting requirements are to be followed.

#### IV. Ethics

Vendors must be committed to the highest standards of ethical conduct when dealing with workers, Vendors, and customers.

- Corruption, Extortion, or Embezzlement - Corruption, extortion, and embezzlement, in any form, are strictly prohibited. Vendors shall not engage in corruption, extortion or embezzlement in any form and violations of this prohibition may result in immediate termination as an Vendor and in legal action.
- Disclosure of Information - Vendors must disclose information regarding its business activities, structure, financial situation, and performance in accordance with applicable laws and regulations and prevailing industry practices.
- No Improper Advantage - Vendors shall not offer or accept bribes or other means of obtaining undue or improper advantage.
- Fair Business, Advertising, and Competition - Vendors must uphold fair business standards in• advertising, sales, and competition.
- Business Integrity - The highest standards of integrity are to be expected in all business interactions. Participants shall prohibit any and all forms of corruption, extortion and embezzlement. Monitoring and enforcement procedures shall be implemented to ensure conformance.



- Community Engagement - Vendors are encouraged to engage the community to help foster social and economic development and to contribute to the sustainability of the communities in which they operate.
- Protection of Intellectual Property - Vendors must respect intellectual property rights; safeguard customer information; and transfer of technology and know-how must be done in a manner that protects intellectual property rights.

V. Management System

Vendors shall adopt or establish a management system whose scope is related to the content of this Code. The management system shall be designed to ensure (a) compliance with applicable laws, regulations and customer requirements related to the Vendors' operations and products; (b) conformance with this Code; and (c) identification and mitigation of operational risks related to this Code. It should also facilitate continual improvement.

The management system should contain the following elements:

- Company Commitment - Corporate social and environmental responsibility statements affirming Vendor's commitment to compliance and continual improvement.
- Management Accountability and Responsibility - Clearly identified company representative[s] responsible for ensuring implementation and periodic review of the status of the management systems.
- Legal and Customer Requirements - Identification, monitoring and understanding of applicable laws, regulations and customer requirements.
- Risk Assessment and Risk Management - Process to identify the environmental, health and safety and labour practice risks associated with Vendor's operations. Determination of the relative significance for each risk and implementation of appropriate procedural and physical controls to ensure regulatory compliance to control the identified risks.
- Performance Objectives with Implementation Plan and Measures - Areas to be included in a risk assessment for health and safety are warehouse and storage facilities, plant/facilities support equipment, laboratories and test areas, sanitation facilities (bathrooms), kitchen/cafeteria and worker housing /dormitories. Written standards, performance objectives, targets and implementation plans including a periodic assessment of Vendor's performance against those objectives.
- Training - Programs for training managers and workers to implement Vendor's policies, procedures and improvement objectives.
- Communication - Process for communicating clear and accurate information about Vendor's performance, practices and expectations to workers, Vendors and customers.

- Worker Feedback and Participation - Ongoing processes to assess employees' understanding of and obtain feedback on practices and conditions covered by this Code and to foster continuous improvement.
- Audits and Assessments - Periodic self-evaluations to ensure conformity to legal and regulatory requirements, the content of the Code and customer contractual requirements related to social and environmental responsibility.
- Corrective Action Process - Process for timely correction of deficiencies identified by internal or external assessments, inspections, investigations and reviews.
- Documentation and Records - Creation of documents and records to ensure regulatory compliance and conformity to company requirements along with appropriate confidentiality to protect privacy.

The Code is modelled on and contains language from the Recognized standards such as International Labour Organization Standards (ILO), Universal Declaration of Human Rights (UDHR), United Nations Convention against Corruption, and the Ethical Trading Initiative (ETI) were used as references in preparing this Code and may be useful sources of additional information.

## **ANNEXURE-I**

# **TECHNICAL SPECIFICATIONS**

**TECHNICAL SPECIFICATION**

**FOR**

**ERECTION, TESTING & COMMISSIONING OF**  
**66/11kV BAKKARWALA GRID SUBSTATION**  
**AT NEW DELHI**  
**ON TURNKEY BASIS**

**( SPEC NO. BRPL-EHV-TS- BKW)**

Prepared by	Javed Ahmed		Rev: 0
Reviewed by	Abhinav Srivastava		Date: 31.07.2022
Approved by	Gopal Nariya		

Technical Specification for 66/11KV Bakkarwala AIS Grid Substation in New Delhi

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**Technical Specification for 66/11KV Bakkarwala AIS Grid Substation in New Delhi**

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**TECHNICAL SPECIFICATION  
FOR  
GENERAL DESIGN CRITERIA**

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 0</b>
<b>Reviewed by</b>	<b>Abhinav Srivastava</b>		<b>Date: 31.07.2022</b>
<b>Approved by</b>	<b>Gopal Nariya</b>		



## **1.0 INTENT OF SPECIFICATION**

This specification is intended to cover complete design, engineering, manufacturing, assembling, testing at manufacturer's works, supply and Transportation F.O.R. site of all equipment and accessories, steel structures, all structural work, substation building, Civil and architectural work, complete erection, testing, commissioning & putting into successful commercial operation of 66/11 KV AIS substation with Pipe bus bar substation including supply of all Labour, supervision, tools & plants and supplies as required.

The 66kV Air insulated Double Bus outdoor substation shall have following bays with equipments and civil works: - Four (04) no's Feeder Bay – Three (03) no's Transformer bay - One (01) no Bus Coupler bay. -Two (02) sets Bus PT.

The substation shall have control room building with 11kV Indoor Switchgear, 66kV Control and Relay Panel, Battery & Battery Charger, ACDB and DCDB etc. The suggestive Layout Plan and Single Line diagram of the substation is enclosed.

This specification shall be read in conjunction with other sections of bidding document. In the event of any discrepancy with the listed document, the most stringent one shall govern. In the tender document, the term 'Contractor', 'Bidder' and 'Vendor' has been used interchangeably.

It is advisable that bidder should visit the site to confirm its present status prior to submission of their bid.

## **2.0 SCOPE OF SUPPLY**

This scope of work shall include design, engineering, manufacture, shop floor testing, inspection, packing, dispatch, loading, unloading and storage at site, transit/storage and construction insurance, assembly, erection, civil structural, architectural work, complete pre-commissioning checks, testing & commissioning at site, obtaining statutory clearance & certification from State Electrical Inspector, Municipal Corporation department, Fire officer, etc. and handing over to the Owner after satisfactory commissioning of complete 66/11 kV substation of BSES Rajdhani Power Ltd. at Bakkarwala, New Delhi.

The scope includes all material, equipment and works required for the construction of the Substation complete with all items considered essential for safe and trouble-free continuous commercial operation of the system in a manner acceptable to the Owner and complying with latest revision of National and International Standards, Codes & Practices, Indian Electricity Rules, CEA (Measures relating to Safety and Electric Supply) Regulations 2010 and Indian Electricity Act.

## Volume – I Technical Specification | General Design Criteria

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The scope of supply broadly includes the following:

### 2.1 Major Equipments:

- 11kV Auto-Switched Capacitor Bank (APFC) Outdoor Type -
  - 7.2 MVAR -2 Sets
  - 3.6 MVAR -2 Sets
- 66/11kV 31.5MVA Power Transformer and NIFPS along with accessories- 2 Sets
- Aluminium Pipe bus for Main and Jack Bus
- 3 Pole SF6, Circuit breaker with support structure-8 nos
- 66KV single phase gapless metal oxide surge arrestor -7 Sets(3 Nos. per set)
- 66KV Current Transformer- 24 Nos.
- 66KV Potential Transformer- 6 Nos.
- 66KV CVT- 12 Nos.
- Horizontally rotating double break motorized isolators with one earth switch-16 Nos.
- Horizontally rotating double break motorized isolators with two earth switch- 2 Nos.
- Horizontally rotating double break motorized tandem isolators without earth switch- 7 Nos.
- Outdoor Bay Marshalling Kiosk – 8 Nos.
- 220V Lithium Ion Battery bank-1 Set
- Battery charger with DCDB -1 Set
- ACDB -1 No.
- Station Aux. Transformer, 11/0.433kV, 400kVA -1 No with Station transformer to ACDB cable shall be 4CX150 sqmm
- SCADA RTU-1 Set
- High mast lights 16 M high-4 Nos

### 2.2 Item as System

- 11kV VCB Switchgear Panel board with Numerical protection relays (refer SLD).
- Earthing trucks for 11KV Panels -2Nos of bus earthing truck and 2Nos of cable earthing truck for each size of panel.
- All Numerical protection Relay shall be supplied with Conformal coating
- Grounding and earthing of entire substation including all the fences such as Power Transformer Fencing, Aux. transformer fencing and capacitor bank fencing as per Technical Specification. 220V Lithium Ion Battery bank, one set of Battery charger compatible with Li Ion battery.
- Outdoor illumination including street lighting with Poles.
- Indoor illumination including emergency lighting (DC lighting incase of black out)
- Air Conditioning, Exhaust and Ventilation for complete substation building.
- Fire detection and alarm system including its SCADA integration.
- Direct stroke lightning protection by shielding spikes.
- 11kV Panel Fire Suppression System including its SCADA integration
- Video Surveillance system including its SCADA integration.
- Material GPS Tracking System.
- Fiber optic Cable including patch cord, LIU splicing inside substation for line differential protection.
- Cable Trench Indoor and Outdoor (Control and Power Cable Trench shall be separate)
- Plinth of Power Transformer shall be considered for minimum 31.5MVA Power Transformer.
- Culvert for road crossing

## **Volume – I Technical Specification | General Design Criteria**

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- The building foundation shall be designed for Ground floor + First floor
- Fire retardant paint for all cable entering to panels till the cable opening
- 6 Months O&M from the date of handing over of Substation (refer Annexure-O for Details).
- AC and DC Failure Hooter near Security gate at any pole
- Digital Substation with Merging unit
- Cyber security readiness substation

### **2.3 Items as Lot**

- LT Power & Control cables (fire retardant type) supply and termination and Glands.
- Building Cable entry Sealing
- Supply and providing 11KV Power cable termination kits and Glands.
- Cable trays
- Supply and ETC of Termination Kits
- Supply and installation of Fire extinguisher
- Direct Stroke Lightning Protection for outdoor equipments
- Maintenance tools & tackles including testing & measuring instruments
- Cabling between equipments and RTU
- Supply Erection testing and commissioning of Line differential protection Relay at remote end
- Rubber Mat for all Indoor equipments front and back side
- Material required for IMS (Entry and Exit Sign, First aid Box, tool kit box)

### **2.4 Civil Works**

- As per Civil specification

### **2.5. Design Work**

Design documentation in sufficient copies including design memo, calculations, general arrangement, plans, elevations and sectional drawings, sag/tension calculations, short circuit calculations, electro-dynamic force calculations, single line diagrams, schematic interconnection drawings, wiring diagrams, foundation calculations, foundation plans/details, cable schedules, bill of materials, lighting system design calculations, earthing system design calculations, illumination system design, calculation, conductor sizing, calculation insulation coordination, protection coordination etc.

- Operation & Maintenance Manuals and As-built drawings. (Six sets hard copy & two sets soft copy)
- Documentation required by State Electrical Inspector or by other statutory body for statutory approval/certification of the Substation installation. (as required)
- Temporary sheds for storage of equipment, tools & tackles, construction offices with required fittings & furnishings.

The above equipment and services are specifically listed for the guidance of the Bidder. Apart from the above, Single Line Diagram and Layout Plan (suggestive) may also be referred for further details of equipment. However, it is to be understood that the Contractor's scope is not limited to the items

## Volume – I Technical Specification | General Design Criteria

specifically listed above but covers all items required for the completion of a safe and fully functional Substation.

### 2.6 Tools and Spares

**Tools & Commissioning Spares:** Contractor should be equipped with all tools, tackles and commissioning spares for successful commissioning of substation.

**Recommended Spares:** Contractor shall be providing the Owner a list of recommended spares along with quantity and market/budgetary prices. This shall be a recommendation only and shall not be a part of quotation for price bid

### 3.0 COMPLETION SCHEDULE

The contractor shall be fully responsible to complete the project in time. It is desired that the total project should complete in 300 days from the date of LOA. The broad completion schedule is attached here under for reference. The detailed completion schedule shall be prepared by contractor in MS-Project or Primavera software and shall be submitted at the time of detail engineering for approval. The detailed schedule shall be finalized with the help of schedule given by Owner.

Activity schedule shall be as tabulated below. The reference date shall be the date of LOA.

SI. No.	Description of Work	Time Line from Zero Date(in days)	Responsibility
1	Zero Date (Letter of Award)	0	BRPL
2	Mobilization of manpower	15	Contractor
3	Inception Report	15	Contractor
4	PERT chart approval / L2 schedule majorly including : <ul style="list-style-type: none"><li>Manpower &amp; Machinery to be deployed</li><li>Procurement of major equipment</li><li>Dispatch schedule of the major item</li><li>Intermediate milestone schedule</li></ul>	15	Contractor
5	Submission of Drawings/Documents/ calculations for Engineering Approval	30	Contractor
6	Engineering Approval	60	BRPL
7	Civil Works	130	Contractor
8	Procurement/Supplies	210	Contractor
9	Equipment Erection	240	Contractor
10	Commissioning of 66kV line	255	BRPL
11	Commissioning of 1 <sup>st</sup> Power Transformer	255	Contractor
12	Commissioning of 2nd Power Transformer	270	Contractor
13	Testing & Commissioning of entire substation	285	Contractor
14	Handing Over	300	Contractor

#### **4.0 ELECTRICITY & WATER FOR CONSTRUCTION**

Electricity Supply and Water for construction purpose shall be arranged by Contractor.

#### **5.0 SUPPLY AND WORKS BY BIDDER**

The termination kits/jumpers, Glands, Cable Seal and interconnections for all the Cables/Conductors shall be in the scope of Contractor. Extension of 48 core (12 Single Mode and 36 Multimode) Fiber optic embedded in Infeed Power Cable and interconnections for all the Cables/Conductors (with all the accessories of 48 core FO including LIU, joint box, patch cord and extension of fiber optic from Power Cable to LIU), shall be in the scope of Contractor. Laying of cables and stringing of Conductors including its hardware fitting and insulators in the substation premises shall also be in the scope of Contractor only. Cable mounting structure for Power transformer Incoming shall be in Contractors scope.

Works for Future Transformer like Transformer Foundation, Cable trench, Earthing, Cable Seal, Cable Trays shall be in Contractors scope. Also Earthing and grounding, DSLP, illumination, trenches for future transformer shall be in Contractors scope.

**.WORKS BY OWNER:** The following works shall be carried out by Owners:

1. Soil Investigation and Soil resistivity test
2. Topographical survey

The trenches and cable trays for Incoming/outgoing cables inside the Substation premises shall be in the scope of Contractor.

#### **6.0 SUPPLIES AS FREE ISSUE ITEMS:**

The following items shall be supplied free of cost to vendor:

- 11 kV 1x1000 sq. mm. XLPE Cables
- 11 kV 3x400 sq. mm. XLPE Cables

However, the termination kits/jumpers, Glands and interconnections for the above Cables/Conductors shall be in the scope of vendor. Laying of these free issued cables, stringing of Conductors including its hardware fitting & insulators and ETC of Power Transformers in the substation premises shall also be in the scope of vendor only.

Free issue and return of items/excess materials Transportation from BRPL Stores to Site or Site to BRPL stores shall be in Vendors Scope of work.

#### **7.0 COORDINATION WITH STATUTORY BODIES & OUTSIDE AGENCIES**

The Contractor shall be fully responsible for getting all statutory clearances, including but not limited to Electrical Inspector clearance, Fire officer or any other statutory bodies for implementation of the work.

The contractor shall be fully responsible for carrying out all co-ordination and liaison work as may be required with Electrical Inspector, Civic Agencies (MCD/DDA/PWD or any other), Horticulture department, Fire officer or any other statutory bodies for implementation of the work.

## Volume – I Technical Specification | General Design Criteria

The application on behalf of BRPL for submission to the Electrical Inspector and other statutory bodies along with copies of drawings complete in all respects shall be done by the contractor & approval / certificates shall be obtained by the contractor well ahead of time so that the actual commissioning of equipment is not delayed for want of inspection and approval by the inspector & statutory bodies. The contractor shall arrange the actual inspection work by Electrical Inspector.

Official fees to electrical inspector / statutory bodies shall be paid by the Contractor.

### 8.0 COORDINATION WITH OTHER CONTRACTOR & OWNER'S SYSTEM

The contractor shall be fully responsible for carrying out all the co-ordination work required with their sub-contractors, if any, as well as with Owners system for execution and completion of work.

### 9.0 TERMINAL POINTS OF CONTRACTOR'S SCOPE

9.1 Up to Line take off point and including provision for Cable termination at the incomer and outgoing bays.

9.2 Outdoor Cable Trenches : Upto the boundary wall of substation

9.3 Lighting/Illumination/Lightning : Within Outdoor & Indoor Substation Area

9.4 Earthing : Within Substation area and building.

9.5 Water supply and drainage at suitable point near the substation boundary wall at location to be decided during detailed engineering.

## 10.0 SALIENT FEATURES, BASIC DESIGN CRITERIA AND MINIMUM TECHNICAL REQUIREMENTS OF 66/11 KV SUBSTATION/SUBSTATION EQUIPMENTS

### 10.1 Introduction

BRPL is setting up 66/11KV AIS with Pipe busbar Grid substation at Bakkarwala New Delhi. The Substation shall be constructed on turnkey EPC execution. EPC contractor is responsible for detailed design also. In this paragraph only salient features, basic design criteria and Owner's minimum technical requirements are enumerated for the guidance of the Bidder. However, this should be referred in conjunction with SLD enclosed. The salient features of substation have been tabulated as under:

Particulars	Description
Voltage Level	66/11 kV
Infeed Plan	66 kV Double Circuit
Infeed arrangement	66 kV U/G Cables
Substation Capacity	2 x 31.5 MVA
Present status of Land	In possession of BRPL
Previous work done at site(if any)	Boundary wall

### 10.2 Substation Capacity

The substation capacity shall be as per the table in Clause no. 9.1 above.

### 10.3 11KV Switchgears

The 11KV Switchgear shall be installed inside the substation building. The switchgears shall be equipped with Vacuum Circuit Breaker. The metering and protection relays shall be part of switchgear only. Control voltage shall be 220 V DC.

### 10.4 66/11KV Power Transformer

The Outdoor Power transformer shall be 25/31.5MVA, ONAN/ONAF with OLTC. The microprocessor based Transformer monitoring relay shall be provided in place of RTCC panel. Each Transformer shall be provided with NIFPS along with its cables, one extra N2 cylinder and extra valves as per specification.

### 10.5 Battery Charger and Battery Bank

The Control supply shall be 220V DC. The Li-Ion Battery bank shall be installed in separate room with proper ventilation system as per safety requirement .The battery charger shall be installed inside control room building and shall be SCADA compatible.

### 10.6 11kV APFC Capacitor Bank

Two set of 7.2MVAR capacitor bank shall be installed outdoor. Each capacitor bank shall have one fixed step of 1.8 MVAR and three steps of 1.8 MVAR. Each sub bank shall be provided with motorized 11KV Isolator cum earth switch, 0.2% series reactors, capacitor switch/vacuum contactor, LA, HT fuses, RVT, Neutral Displacement Relay (numerical type), Under voltage Relay, Automatic power factor controller and all necessary equipment for auto switching.

Two set of 3.6MVAR capacitor bank shall be installed outdoor. Each capacitor bank shall have one fixed step of 1.8 MVAR and one steps of 1.8 MVAR. Each sub bank shall be provided with motorized 11KV Isolator cum earth switch, 0.2% series reactors, capacitor switch/vacuum contactor, LA, HT fuses, RVT, Neutral Displacement Relay (numerical type), Under voltage Relay. Automatic power factor controller and all necessary equipment for auto switching

### 10.7 Protection coordination through ETAP Software.

### 10.8 Power and Control cable -

All power and control cables within substation premise will be laid in single piece. No cable joint shall be accepted within substation premise.

### 10.9 Other Parameters for 66 KV Substation

Following parameters /service conditions shall prevail for entire system design under the scope of this turnkey project:

## Volume – I Technical Specification | General Design Criteria

### General Service Condition

S. No	Particulars	Data
1	Design Ambient temperature	50 °C
2	Seismic Condition	Zone IV as per IS 1893
3	Wind Pressure	195 kg/M <sup>2</sup> upto elevation of 30 M as per IS 875
4	Maximum Relative Humidity	100%
5	Maximum Altitude above Sea level	1000M
6	Rainfall	750mm (concentrated in 4 months)
7	Pollution level	Heavy/Dry

### System Parameters

S. No.	Parameters	HV Side	LV Side
1	Nominal Voltage (kV)	66	11
2	Rated Voltage (kV)	72.5	12
3	Rated Frequency (Hz)	50 +/- 3%	50 +/- 3%
4	System Neutral Earthing	Solidly Grounded	Solidly Grounded
5	Short Circuit rating (for 3 sec)	3600 MVA / 31.5 kA	500 MVA / 26.3 kA
6	Basic Insulation Level		
6.1	Impulse frequency withstand voltage (kVp)	325	75
6.2	Power frequency withstand voltage (kV rms)	140	28
7	Internal arc withstand capability kA/s	-	26.3kA for 1 sec

### Parameters for outdoor Switchyard Equipments (66kV)

S.No	Particulars	66kV	11kV
1	Minimum Creepage	31mm/KV	31mm/KV
2	Minimum Clearances		
2.1	Phase to Phase	630 mm	280mm
2.2	Phase to Earth	630 mm	140mm
3	Safety Clearances		
3.1	Sectional Clearances	3000 mm	
3.2	Height of lowest live point on the insulator from the ground	4300 mm	
4	Bus Configuration	Double Bus	Single Bus
5	Conductor	Silver Platted/tinned electrolytic copper / ACSR Zebra(For Jumpering)	Silver Platted/tinned electrolytic copper



## Volume – I Technical Specification | General Design Criteria

### Site Service Conditions (considering main external road at 0.00 level)

S. No.	Particulars	Level
1	Substation Road level	+750 mm
2	Final top level of gravel in outdoor yard	+750 mm
3	Final top level of Equipment & gantry foundation	+1050 mm
4	Control Room Building Plinth Level	+1500 mm

### 11.0 CODES & STANDARDS

The contractor shall follow latest Indian Standards or international standard. Refer respective equipment specification for applicable standards.

### 12.0 ENGINEERING DELIVERABLES

The Bidder shall submit following minimum Engineering Deliverables from award of the Contract. Any other drawing / calculation which is not listed below and may be required for execution of the job shall also be submitted by the bidder.

S. No.	Drawing Title
<b>A.</b>	Inception report including work schedule and PERT chart within two weeks from LOA(Letter of Award)
<b>B.</b>	<b>Electrical Drawing</b>
1	Main Single Line Diagram indicating bus/breaker rating, cable/overhead conductor size, fault levels of different voltage grade, Transformer details, metering and protection with CT / PT cores / ratio / burden / accuracy class.
2	Complete BOQ of the substation with technical details.
3	Single Line Diagram of 415 V AC Distribution board
4	Single Line Diagram of 220V DC Distribution board
5	Overall Site Layout Plan
6	Maximum & Minimum fault level calculation for the substations
7	Insulation coordination
8	Switchgear/Control building layout – Plan
9	Cable trench layout Plan & Section – outdoor
10	Cable tray layout Plan & Section – Indoor
11	BOQ of Cable trays and accessories
12	Sizing calculation of LV Cables
13	Power cable schedules
14	Control cable schedules
15	BOQ of Cables
16	Codification of cable trays and cable tray/cable tag marking concept
17	Ground mat design Calculation from actual site soil investigation
18	Drawing of ground mat along with BOQ
19	Drawing of Indoor equipment grounding details
20	Outdoor equipment grounding arrangement and details
21	Input /Output list of SCADA system
22	Outdoor Illumination system design Calculation
23	Indoor Illumination system design Calculation
24	Drawing of Outdoor Illumination with erection details
25	Drawing of Indoor Illumination with erection details

## Volume – I Technical Specification | General Design Criteria

S. No.	Drawing Title
26	Complete BOQ indoor and outdoor illumination system
27	CT/PT sizing/detail calculation of burden, knee point voltage
28	All major equipment sizing calculation
29	Cabling, earthing & lightning concept
30	Power Transformer foundation details, soak pit arrangement, firewall segregation
31	Fire fighting arrangement of Transformers and indoor equipments
32	Relay setting with calculations
33	Switchgears details and its calculations
34	As built documentation of the drawing / documents
35	DC Sizing Calculation
36	Exhaust and Ventilation
37	All the other required design Documents
<b>C. Civil Drawings</b>	
S. No	Drawing Title
1	Layout Plan For Control Building
2	RCC detail of Control Room Building
3	RCC detail of Outdoor Cable Trench including trench cover
4	GA & RCC detail of Transformer foundation & Oil Soak pit
5	GA & RCC detail of Auxiliary Transformer
6	GA & RCC detail of Capacitor Bank
7	GA & RCC detail of Burnt Oil Tank
8	GA & RCC detail of Lighting poles
9	GA & RCC detail of Equipment foundation
10	Structural Detail of Equipment
11	Overall layout plan indicating landscaping.
12	Detail of Fire wall
13	GA & RCC detail of NIFPS System
14	Detail of Water Supply and Sanitary system
15	GA & RCC detail of Septic Tank
16	Detail of Rainwater Harvesting System (detail of recharge pit)
17	GA & RCC detail of Underground Water Tank
18	GA and detail of fencing with gates of Switchyard, Capacitor Bank & Auxiliary Transformer
19	GA and Section of Road & Storm Water Drain
20	RCC detail of Security Gumtee
21	Outdoor Trench layout for switch yard
22	Sectional Details for Outdoor Trenches
23	Conduit plan for Control room building.
24	Switch yard layout

### 13.0 SUBMISSION OF DRAWINGS & OTHER DOCUMENTS

BOQ, Calculations and other documents etc. shall be on A4 size paper. All the drawings shall be drawn to the scale as far as possible on A3 size or larger size paper and should be legible. The drawings shall be submitted in colour copy. The submission shall be

- Three (03) Sets of drawings/BOQ/Calculation for Owners review and approval.
- Three (03) Sets of approved drawings/BOQ/Calculation for construction reference.

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- Six (06) Sets of final As Built drawings, design, BOQ, Calculation. O&M manual for all equipments supplied.
- Soft copies of all drawings/Documents/calculation in Auto CAD and Microsoft office file format as applicable.

Drawings shall be treated as submitted, only if provided with BOQ (If applicable). Transmittal sheet shall be mandatory to attach with all the drawing and documents. Format for transmittal shall be provided to successful bidder for drawing approvals etc.

### **14.0 TEST CERTIFICATES**

All equipments shall be tested as per their corresponding specification in Tender document. All tests (Type test, Routine test, Acceptance test) shall be carried out at bidders cost. However prices against special test for equipments have to be quoted separately. Special test shall be Owners decision.

Type and Special test has to be carried out at CPRI/ERDA or as mentioned in specification. Routine, and Acceptance tests may be carried out at manufacturer's lab.

Bidder shall submit type test certificate of all the equipment with validity of five years (on the date of bid opening carried out at CPRI/ERDA).

### **15.0 QUALITY PLAN**

#### **15.1 Manufacturing Quality Plan**

Manufacturing Quality plan with respect to all major equipment and work has to be submitted by the successful bidder for following as a minimum:

- I. An outline of the proposed work and execution plan for approval.
- II. The structure of the supplier's organization for the contract
- III. The duties and responsibilities assigned to staff ensuring quality of work for the contract
- IV. Hold and notification points
- V. Submission of engineering documents required as per specification
- VI. The inspection of materials and components Inspection during fabrication /construction
- VII. Final inspection & tests

Successful bidder shall include submittal of bills invoice, Bill of lading, and factory test certificate for grade, physical tests, dimension, and specific watt loss per kg of core material to the purchaser for verification in quality plan suitably.

#### **14.2 Field Quality Plan**

- 14.2.1 Quality Assurance Plan for various stages of execution work shall be submitted by Contractor for approval of Owner. The plan should include the Organization structure so the Safety personnel to ensure the Manpower and Material safety during the entire duration of execution.
- 14.2.2 Environment, Health and Safety (EHS) shall be covered in the plan submitted by Contractor.
- 14.2.3 A checklist to ensure the quality of equipment installation shall be submitted by Contractor for approval

### **16.0 INSPECTION**

As per Chapter 40 (Training and Inspection) Volume - 1

### **17.0 TRAINING OF BRPL OFFICIALS**

As per Chapter 40 (Training and Inspection) Volume - 1

### **18.0 MONITORING OF MATERIAL DISPATCH STATUS**

Once the material is dispatched after Final clearance Transport Vehicle shall have GPS Tracking Device (Preferably Map My India Asset Tracking Device) and status of dispatch of material shall be sent to all the stake holders via SMS thru GPS Device. This shall be applicable to all the major equipments like GIS Panels, HT Panel, and Power Transformers, CRP and RTU.

### **19.0 OPERATION AND AFTER SALE SERVICES**

Contractor shall carry out all day to day operations of entire Substation after successful commissioning for a period of 6Months. Contractor shall assign 24x7 operating personnel for operation activities.

Contractor shall appoint appropriate after sale services staff for all necessary service requirements for a period of 6 Months. Contractor shall keep all necessary spares, tools & tackles, T& P, testing equipments for successful operation and maintenance requirement for said period.

Contractor shall provide after sale support for the tenure of stipulated time.

Responsibility of Contractor O&M Engineer shall include:

- a) Training of BRPL officials on successful operation of all the substation equipment including switchgears , Relays and SCADA.
- b) Operation and Maintenance of entire substation including all switchgears, Relays and SCADA.
- c) Refer Annexure-O for details

**TECHNICAL SPECIFICATION**  
**FOR**  
**CIVIL WORK**

<b>Prepared by</b>	<b>Amrita Singh</b>		<b>Rev: 0</b>
<b>Reviewed by</b>			<b>Date: 30<sup>th</sup> July, 2022</b>
<b>Approved by</b>	<b>Ajay Karan</b>		

## **Volume – I Technical Specification for Civil Work**

### **1.0 GENERAL REQUIREMENT**

- 1.1. This chapter includes the technical requirements for 66kV Sub-station at Bakkarwala including associated design and preparation of all civil & structural drawings and execution of all associated civil works. This chapter deals mainly with technical specifications for the design, supervision and construction of complete civil & structural works.
- 1.2. The specifications are intended for general description of work, quality and workmanship. The specifications are not however exhaustive to cover minute details and the work shall be executed according to relevant latest Indian Standards / IRC specifications / CPWD specifications. In the absence of the above, the work shall be executed according to the best prevailing practices in the trade, recommendations of relevant American or British Standards or as per the instructions of Engineer. The IS standards / IRC specifications / CPWD specifications to be followed are mentioned in the technical specifications attached hereto. They shall be latest editions / version of the same. The Contractor is expected to get himself clarified on any doubts about the specifications, BOQ, etc. before bidding of the Tender.
- 1.3. The work shall be carried out according to the design / drawings to be developed by the Contractor and approved by the Owner based on Tender Drawings (tentative layout) supplied to the Contractor by the Owner. For all buildings, structures, foundations, etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the Sub-Station 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 purpose only. However, the Contractor shall quote according to the complete requirement.
- 1.4. The Contractor shall take all necessary precautions to protect all the existing equipment, structures, facilities & buildings, etc. from damage. In case any damage occurs due to the activities of the Contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be made good by the Contractor at his own cost to the satisfaction of the Engineer. The Contractor shall also take all necessary safety measures, at his own cost, to avoid any harm / injury to his workers and staff from the equipment & facilities of the power station.
- 1.5. During the progress of work, the Engineer will exercise supervision of the work to ensure that the technical provisions of the contract are being followed and the work is being executed accurately and properly. However, such supervision shall in no way relieve the Contractor of the responsibility for executing the work in accordance with the specifications.
- 1.6. Before submitting the bid, the Contractor shall inspect and examine the site and its surroundings and shall satisfy himself as to the nature of the ground and subsoil, the availability of materials necessary for completion of the work, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.
- 1.7. In view of pandemic, the Contractor shall be bound to follow all guidelines issued by the Government & take all necessary arrangements & precautions for his workers & staff.

### **2.0 GEOTECHNICAL INVESTIGATION**

The Owner has carried out Geo Technical Investigation and Topographical Survey for the entire Sub-Station including switchyard. The copy of the report is attached with the tender document as input to Contractor for Civil Design & Estimation Work.

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**3.0 SITE PREPARATION**

**3.1. Scope**

3.1.1. This clause covers the design and execution of the work and site preparation such as clearing of the site, the supply and compaction of fill material as per requirement upto desired formation levels, excavation and compaction of backfill for foundations, road construction, drainage, trenches, etc..

**3.2. General**

3.2.1. The layout and levels of all structures, etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks finalized / approved by the Owner. (The required filling up to formation level shall be in the scope of Vendor). The Contractor 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.

3.2.2. The Owner shall provide a boundary wall all around the plot with 02 entry gates. Contractor shall have to make good to all the damages to the boundary wall and gate during work execution, if occurs.

3.2.3. Contractor shall develop a building layout and other layouts so that if the trees are there inside the grid plot, they may be escaped from cutting. In extreme conditions when the tree cutting is unavoidable, necessary liaison for permission shall be on part of Contractor from respective Govt. Agency. Requisite formalities shall be carried out by Owner. Fee shall be borne by the Owner. Compensatory plantation shall be done (if required) by Contractor; BRPL shall provide space for the same.

3.2.4. The Contractor shall develop the site area to meet the requirements of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specification.

3.2.5. If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be designed to prevent the erosion by wind and water of material from its final compacted position or the in-situ position of undisturbed soil.

3.2.6. Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the Owner.

3.2.7. Backfill material around foundations or other works shall be suitable for the purpose for which it is used and shall be compacted to the density described under Compaction (clause 3.4 of this Specification). Excavated material not suitable or not required for backfill shall be disposed off by the Contractor in areas as directed by Owner upto a maximum lead of 5 km. Backfill material if found having mix of earth and fly ash should not be used for top 30 cm of formation level and should be supplemented with good earth at the cost of Contractor.

**3.3. Excavation and Backfill**

3.3.1. Excavation and backfill for foundations shall be in accordance with the relevant code.

3.3.2. Whenever water level is met during the excavation, it shall be dewatered and water level

**Volume – I Technical Specification for Civil Work**

shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling. Nothing extra shall be payable by the Owner on this account.

- 3.3.3. 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 face shall measure not more than 1 m in height.
- 3.3.4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compaction of the material in successive uniform horizontal layers not exceeding 15 cm 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 10 cm in any direction shall not be placed in embankment adjacent to the structures.
- 3.3.5. 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**

- 3.4.1. The density to which fill materials shall be compacted shall be as per relevant IS code and as per direction of the Owner. All compacted sand filling shall be confined as far as possible. 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 a minimum of 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).
- 3.4.2. At all times unfinished construction shall have an adequate drainage system. Upon completion of the road surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.
- 3.4.3. 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**

- 3.5.1. 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 has to be approved by the Owner.



**TECHNICAL SPECIFICATION**

**FOR**

**ERECTION, TESTING & COMMISSIONING OF**  
**66/11kV BAKKARWALA GRID SUBSTATION**  
**AT NEW DELHI**  
**ON TURNKEY BASIS**

**( SPEC NO. BRPL-EHV-TS- BKW)**

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 0</b>
<b>Reviewed by</b>	<b>Abhinav Srivastava</b>		<b>Date: 31.07.2022</b>
<b>Approved by</b>	<b>Gopal Nariya</b>		

Technical Specification for 66/11KV Bakkarwala AIS Grid Substation in New Delhi

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**Technical Specification for 66/11KV Bakkarwala AIS Grid Substation in New Delhi**

**SCHEDULE & ANNEXURE**

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**Technical Specification for 66/11KV Bakkarwala AIS Grid Substation in New Delhi**

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**TECHNICAL SPECIFICATION**  
**FOR**  
**GENERAL DESIGN CRITERIA**

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 0</b>
<b>Reviewed by</b>	<b>Abhinav Srivastava</b>		<b>Date: 31.07.2022</b>
<b>Approved by</b>	<b>Gopal Nariya</b>		

### 1.0 INTENT OF SPECIFICATION

This specification is intended to cover complete design, engineering, manufacturing, assembling, testing at manufacturer's works, supply and Transportation F.O.R. site of all equipment and accessories, steel structures, all structural work, substation building, Civil and architectural work, complete erection, testing, commissioning & putting into successful commercial operation of 66/11 KV AIS substation with Pipe bus bar substation including supply of all Labour, supervision, tools & plants and supplies as required.

The 66kV Air insulated Double Bus outdoor substation shall have following bays with equipments and civil works: - Four (04) no's Feeder Bay – Three (03) no's Transformer bay - One (01) no Bus Coupler bay. -Two (02) sets Bus PT.

The substation shall have control room building with 11kV Indoor Switchgear, 66kV Control and Relay Panel, Battery & Battery Charger, ACDB and DCDB etc. The suggestive Layout Plan and Single Line diagram of the substation is enclosed.

This specification shall be read in conjunction with other sections of bidding document. In the event of any discrepancy with the listed document, the most stringent one shall govern. In the tender document, the term 'Contractor', 'Bidder' and 'Vendor' has been used interchangeably.

It is advisable that bidder should visit the site to confirm its present status prior to submission of their bid.

### 2.0 SCOPE OF SUPPLY

This scope of work shall include design, engineering, manufacture, shop floor testing, inspection, packing, dispatch, loading, unloading and storage at site, transit/storage and construction insurance, assembly, erection, civil structural, architectural work, complete pre-commissioning checks, testing & commissioning at site, obtaining statutory clearance & certification from State Electrical Inspector, Municipal Corporation department, Fire officer, etc. and handing over to the Owner after satisfactory commissioning of complete 66/11 kV substation of BSES Rajdhani Power Ltd. at Bakkarwala, New Delhi.

The scope includes all material, equipment and works required for the construction of the Substation complete with all items considered essential for safe and trouble-free continuous commercial operation of the system in a manner acceptable to the Owner and complying with latest revision of National and International Standards, Codes & Practices, Indian Electricity Rules, CEA (Measures relating to Safety and Electric Supply) Regulations 2010 and Indian Electricity Act.

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The scope of supply broadly includes the following:

### 2.1 Major Equipments:

- 11kV Auto-Switched Capacitor Bank (APFC) Outdoor Type -
  - 7.2 MVAR -2 Sets
  - 3.6 MVAR -2 Sets
- 66/11kV 31.5MVA Power Transformer and NIFPS along with accessories- 2 Sets
- Aluminium Pipe bus for Main and Jack Bus
- 3 Pole SF6, Circuit breaker with support structure-8 nos
- 66KV single phase gapless metal oxide surge arrester -7 Sets(3 Nos. per set)
- 66KV Current Transformer- 24 Nos.
- 66KV Potential Transformer- 6 Nos.
- 66KV CVT- 12 Nos.
- Horizontally rotating double break motorized isolators with one earth switch-16 Nos.
- Horizontally rotating double break motorized isolators with two earth switch- 2 Nos.
- Horizontally rotating double break motorized tandem isolators without earth switch- 7 Nos.
- Outdoor Bay Marshalling Kiosk – 8 Nos.
- 220V Lithium Ion Battery bank-1 Set
- Battery charger with DCDB -1 Set
- ACDB -1 No.
- Station Aux. Transformer, 11/0.433kV, 400kVA -1 No with Station transformer to ACDB cable shall be 4CX150 sqmm
- SCADA RTU-1 Set
- High mast lights 16 M high-4 Nos

### 2.2 Item as System

- 11kV VCB Switchgear Panel board with Numerical protection relays (refer SLD).
- Earthing trucks for 11KV Panels -2Nos of bus earthing truck and 2Nos of cable earthing truck for each size of panel.
- All Numerical protection Relay shall be supplied with Conformal coating
- Grounding and earthing of entire substation including all the fences such as Power Transformer Fencing, Aux. transformer fencing and capacitor bank fencing as per Technical Specification. 220V Lithium Ion Battery bank, one set of Battery charger compatible with Li Ion battery.
- Outdoor illumination including street lighting with Poles.
- Indoor illumination including emergency lighting (DC lighting incase of black out)
- Air Conditioning, Exhaust and Ventilation for complete substation building.
- Fire detection and alarm system including its SCADA integration.
- Direct stroke lightning protection by shielding spikes.
- 11kV Panel Fire Suppression System including its SCADA integration
- Video Surveillance system including its SCADA integration.
- Material GPS Tracking System.
- Fiber optic Cable including patch cord, LIU splicing inside substation for line differential protection.
- Cable Trench Indoor and Outdoor (Control and Power Cable Trench shall be separate)
- Plinth of Power Transformer shall be considered for minimum 31.5MVA Power Transformer.
- Culvert for road crossing

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- The building foundation shall be designed for Ground floor + First floor
- Fire retardant paint for all cable entering to panels till the cable opening
- 6 Months O&M from the date of handing over of Substation (refer Annexure-O for Details).
- AC and DC Failure Hooter near Security gate at any pole
- Digital Substation with Merging unit
- Cyber security readiness substation

### **2.3 Items as Lot**

- LT Power & Control cables (fire retardant type) supply and termination and Glands.
- Building Cable entry Sealing
- Supply and providing 11KV Power cable termination kits and Glands.
- Cable trays
- Supply and ETC of Termination Kits
- Supply and installation of Fire extinguisher
- Direct Stroke Lightning Protection for outdoor equipments
- Maintenance tools & tackles including testing & measuring instruments
- Cabling between equipments and RTU
- Supply Erection testing and commissioning of Line differential protection Relay at remote end
- Rubber Mat for all Indoor equipments front and back side
- Material required for IMS (Entry and Exit Sign, First aid Box, tool kit box)

### **2.4 Civil Works**

- As per Civil specification

### **2.5. Design Work**

Design documentation in sufficient copies including design memo, calculations, general arrangement, plans, elevations and sectional drawings, sag/tension calculations, short circuit calculations, electro-dynamic force calculations, single line diagrams, schematic interconnection drawings, wiring diagrams, foundation calculations, foundation plans/details, cable schedules, bill of materials, lighting system design calculations, earthing system design calculations, illumination system design, calculation, conductor sizing, calculation insulation coordination, protection coordination etc.

- Operation & Maintenance Manuals and As-built drawings. (Six sets hard copy & two sets soft copy)
- Documentation required by State Electrical Inspector or by other statutory body for statutory approval/certification of the Substation installation. (as required)
- Temporary sheds for storage of equipment, tools & tackles, construction offices with required fittings & furnishings.

The above equipment and services are specifically listed for the guidance of the Bidder. Apart from the above, Single Line Diagram and Layout Plan (suggestive) may also be referred for further details of equipment. However, it is to be understood that the Contractor's scope is not limited to the items



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specifically listed above but covers all items required for the completion of a safe and fully functional Substation.

### 2.6 Tools and Spares

**Tools & Commissioning Spares:** Contractor should be equipped with all tools, tackles and commissioning spares for successful commissioning of substation.

**Recommended Spares:** Contractor shall be providing the Owner a list of recommended spares along with quantity and market/budgetary prices. This shall be a recommendation only and shall not be a part of quotation for price bid

### 3.0 COMPLETION SCHEDULE

The contractor shall be fully responsible to complete the project in time. It is desired that the total project should complete in *300 days* from the date of LOA. The broad completion schedule is attached here under for reference. The detailed completion schedule shall be prepared by contractor in MS-Project or Primavera software and shall be submitted at the time of detail engineering for approval. The detailed schedule shall be finalized with the help of schedule given by Owner.

Activity schedule shall be as tabulated below. The reference date shall be the date of LOA.

Sl. No.	Description of Work	Time Line from Zero Date(in days)	Responsibility
1	Zero Date (Letter of Award)	0	BRPL
2	Mobilization of manpower	15	Contractor
3	Inception Report	15	Contractor
4	PERT chart approval / L2 schedule majorly including : <ul style="list-style-type: none"><li>• Manpower &amp; Machinery to be deployed</li><li>• Procurement of major equipment</li><li>• Dispatch schedule of the major item</li><li>• Intermediate milestone schedule</li></ul>	15	Contractor
5	Submission of Drawings/Documents/ calculations for Engineering Approval	30	Contractor
6	Engineering Approval	60	BRPL
7	Civil Works	130	Contractor
8	Procurement/Supplies	210	Contractor
9	Equipment Erection	240	Contractor
10	Commissioning of 66kV line	255	BRPL
11	Commissioning of 1 <sup>st</sup> Power Transformer	255	Contractor
12	Commissioning of 2nd Power Transformer	270	Contractor
13	Testing & Commissioning of entire substation	285	Contractor
14	Handing Over	300	Contractor

#### **4.0 ELECTRICITY & WATER FOR CONSTRUCTION**

Electricity Supply and Water for construction purpose shall be arranged by Contractor.

#### **5.0 SUPPLY AND WORKS BY BIDDER**

The termination kits/jumpers, Glands, Cable Seal and interconnections for all the Cables/Conductors shall be in the scope of Contractor. Extension of 48 core (12 Single Mode and 36 Multimode) Fiber optic embedded in Infeed Power Cable and interconnections for all the Cables/Conductors (with all the accessories of 48 core FO including LIU, joint box, patch cord and extension of fiber optic from Power Cable to LIU), shall be in the scope of Contractor. Laying of cables and stringing of Conductors including its hardware fitting and insulators in the substation premises shall also be in the scope of Contractor only. Cable mounting structure for Power transformer Incoming shall be in Contractors scope.

Works for Future Transformer like Transformer Foundation, Cable trench, Earthing, Cable Seal, Cable Trays shall be in Contractors scope. Also Earthing and grounding, DSLP, illumination, trenches for future transformer shall be in Contractors scope.

**WORKS BY OWNER:** The following works shall be carried out by Owners:

1. Soil Investigation and Soil resistivity test
2. Topographical survey

The trenches and cable trays for Incoming/outgoing cables inside the Substation premises shall be in the scope of Contractor.

#### **6.0 SUPPLIES AS FREE ISSUE ITEMS:**

The following items shall be supplied free of cost to vendor:

- 11 kV 1x1000 sq. mm. XLPE Cables
- 11 kV 3x400 sq. mm. XLPE Cables

However, the termination kits/jumpers, Glands and interconnections for the above Cables/Conductors shall be in the scope of vendor. Laying of these free issued cables, stringing of Conductors including its hardware fitting & insulators and ETC of Power Transformers in the substation premises shall also be in the scope of vendor only.

Free issue and return of items/excess materials Transportation from BRPL Stores to Site or Site to BRPL stores shall be in Vendors Scope of work.

#### **7.0 COORDINATION WITH STATUTORY BODIES & OUTSIDE AGENCIES**

The Contractor shall be fully responsible for getting all statutory clearances, including but not limited to Electrical Inspector clearance, Fire officer or any other statutory bodies for implementation of the work.

The contractor shall be fully responsible for carrying out all co-ordination and liaison work as may be required with Electrical Inspector, Civic Agencies (MCD/DDA/PWD or any other), Horticulture department, Fire officer or any other statutory bodies for implementation of the work.

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The application on behalf of BRPL for submission to the Electrical Inspector and other statutory bodies along with copies of drawings complete in all respects shall be done by the contractor & approval / certificates shall be obtained by the contractor well ahead of time so that the actual commissioning of equipment is not delayed for want of inspection and approval by the inspector & statutory bodies. The contractor shall arrange the actual inspection work by Electrical Inspector.

Official fees to electrical inspector / statutory bodies shall be paid by the Contractor.

### 8.0 COORDINATION WITH OTHER CONTRACTOR & OWNER'S SYSTEM

The contractor shall be fully responsible for carrying out all the co-ordination work required with their sub-contractors, if any, as well as with Owners system for execution and completion of work.

### 9.0 TERMINAL POINTS OF CONTRACTOR'S SCOPE

9.1 Up to Line take off point and including provision for Cable termination at the incomer and outgoing bays.

9.2 Outdoor Cable Trenches : Upto the boundary wall of substation

9.3 Lighting/Illumination/Lightning : Within Outdoor & Indoor Substation Area

9.4 Earthing : Within Substation area and building.

9.5 Water supply and drainage at suitable point near the substation boundary wall at location to be decided during detailed engineering.

### 10.0 SALIENT FEATURES, BASIC DESIGN CRITERIA AND MINIMUM TECHNICAL REQUIREMENTS OF 66/11 KV SUBSTATION/SUBSTATION EQUIPMENTS

#### 10.1 Introduction

BRPL is setting up 66/11KV AIS with Pipe busbar Grid substation at Bakkarwala New Delhi. The Substation shall be constructed on turnkey EPC execution. EPC contractor is responsible for detailed design also. In this paragraph only salient features, basic design criteria and Owner's minimum technical requirements are enumerated for the guidance of the Bidder. However, this should be referred in conjunction with SLD enclosed. The salient features of substation have been tabulated as under:

Particulars	Description
Voltage Level	66/11 kV
Infeed Plan	66 kV Double Circuit
Infeed arrangement	66 kV U/G Cables
Substation Capacity	2 x 31.5 MVA
Present status of Land	In possession of BRPL
Previous work done at site(if any)	Boundary wall

### 10.2 Substation Capacity

The substation capacity shall be as per the table in Clause no. 9.1 above.

### 10.3 11KV Switchgears

The 11KV Switchgear shall be installed inside the substation building. The switchgears shall be equipped with Vacuum Circuit Breaker. The metering and protection relays shall be part of switchgear only. Control voltage shall be 220 V DC.

### 10.4 66/11KV Power Transformer

The Outdoor Power transformer shall be 25/31.5MVA, ONAN/ONAF with OLTC. The microprocessor based Transformer monitoring relay shall be provided in place of RTCC panel. Each Transformer shall be provided with NIFPS along with its cables, one extra N2 cylinder and extra valves as per specification.

### 10.5 Battery Charger and Battery Bank

The Control supply shall be 220V DC. The Li-Ion Battery bank shall be installed in separate room with proper ventilation system as per safety requirement .The battery charger shall be installed inside control room building and shall be SCADA compatible.

### 10.6 11kV APFC Capacitor Bank

Two set of 7.2MVAR capacitor bank shall be installed outdoor. Each capacitor bank shall have one fixed step of 1.8 MVAR and three steps of 1.8 MVAR. Each sub bank shall be provided with motorized 11KV Isolator cum earth switch, 0.2% series reactors, capacitor switch/vacuum contactor, LA, HT fuses, RVT, Neutral Displacement Relay (numerical type), Under voltage Relay, Automatic power factor controller and all necessary equipment for auto switching.

Two set of 3.6MVAR capacitor bank shall be installed outdoor. Each capacitor bank shall have one fixed step of 1.8 MVAR and one steps of 1.8 MVAR. Each sub bank shall be provided with motorized 11KV Isolator cum earth switch, 0.2% series reactors, capacitor switch/vacuum contactor, LA, HT fuses, RVT, Neutral Displacement Relay (numerical type), Under voltage Relay. Automatic power factor controller and all necessary equipment for auto switching

### 10.7 Protection coordination through ETAP Software.

### 10.8 Power and Control cable -

All power and control cables within substation premise will be laid in single piece. No cable joint shall be accepted within substation premise.

### 10.9 Other Parameters for 66 KV Substation

Following parameters /service conditions shall prevail for entire system design under the scope of this turnkey project:

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### General Service Condition

S. No	Particulars	Data
1	Design Ambient temperature	50 °C
2	Seismic Condition	Zone IV as per IS 1893
3	Wind Pressure	195 kg/M <sup>2</sup> upto elevation of 30 M as per IS 875
4	Maximum Relative Humidity	100%
5	Maximum Altitude above Sea level	1000M
6	Rainfall	750mm (concentrated in 4 months)
7	Pollution level	Heavy/Dry

### System Parameters

S. No.	Parameters	HV Side	LV Side
1	Nominal Voltage (kV)	66	11
2	Rated Voltage (kV)	72.5	12
3	Rated Frequency (Hz)	50 +/- 3%	50 +/- 3%
4	System Neutral Earthing	Solidly Grounded	Solidly Grounded
5	Short Circuit rating (for 3 sec)	3600 MVA / 31.5 kA	500 MVA / 26.3 kA
6	Basic Insulation Level		
6.1	Impulse frequency withstand voltage (kVp)	325	75
6.2	Power frequency withstand voltage (kV rms)	140	28
7	Internal arc withstand capability kA/s	-	26.3kA for 1 sec

### Parameters for outdoor Switchyard Equipments (66kV)

S.No	Particulars	66kV	11kV
1	Minimum Creepage	31mm/KV	31mm/KV
2	Minimum Clearances		
2.1	Phase to Phase	630 mm	280mm
2.2	Phase to Earth	630 mm	140mm
3	Safety Clearances		
3.1	Sectional Clearances	3000 mm	
3.2	Height of lowest live point on the insulator from the ground	4300 mm	
4	Bus Configuration	Double Bus	Single Bus
5	Conductor	Silver Platted/tinned electrolytic copper / ACSR Zebra(For Jumpering)	Silver Platted/tinned electrolytic copper

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### Site Service Conditions (considering main external road at 0.00 level)

S. No.	Particulars	Level
1	Substation Road level	+750 mm
2	Final top level of gravel in outdoor yard	+750 mm
3	Final top level of Equipment & gantry foundation	+1050 mm
4	Control Room Building Plinth Level	+1500 mm

### 11.0 CODES & STANDARDS

The contractor shall follow latest Indian Standards or international standard. Refer respective equipment specification for applicable standards.

### 12.0 ENGINEERING DELIVERABLES

The Bidder shall submit following minimum Engineering Deliverables from award of the Contract. Any other drawing / calculation which is not listed below and may be required for execution of the job shall also be submitted by the bidder.

S. No.	Drawing Title
<b>A.</b>	Inception report including work schedule and PERT chart within two weeks from LOA(Letter of Award)
<b>B.</b>	<b>Electrical Drawing</b>
1	Main Single Line Diagram indicating bus/breaker rating, cable/overhead conductor size, fault levels of different voltage grade, Transformer details, metering and protection with CT / PT cores / ratio / burden / accuracy class.
2	Complete BOQ of the substation with technical details.
3	Single Line Diagram of 415 V AC Distribution board
4	Single Line Diagram of 220V DC Distribution board
5	Overall Site Layout Plan
6	Maximum & Minimum fault level calculation for the substations
7	Insulation coordination
8	Switchgear/Control building layout – Plan
9	Cable trench layout Plan & Section – outdoor
10	Cable tray layout Plan & Section – Indoor
11	BOQ of Cable trays and accessories
12	Sizing calculation of LV Cables
13	Power cable schedules
14	Control cable schedules
15	BOQ of Cables
16	Codification of cable trays and cable tray/cable tag marking concept
17	Ground mat design Calculation from actual site soil investigation
18	Drawing of ground mat along with BOQ
19	Drawing of Indoor equipment grounding details
20	Outdoor equipment grounding arrangement and details
21	Input /Output list of SCADA system
22	Outdoor Illumination system design Calculation
23	Indoor Illumination system design Calculation
24	Drawing of Outdoor Illumination with erection details
25	Drawing of Indoor Illumination with erection details

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S. No.	Drawing Title
26	Complete BOQ indoor and outdoor illumination system
27	CT/PT sizing/detail calculation of burden, knee point voltage
28	All major equipment sizing calculation
29	Cabling, earthing & lightning concept
30	Power Transformer foundation details, soak pit arrangement, firewall segregation
31	Fire fighting arrangement of Transformers and indoor equipments
32	Relay setting with calculations
33	Switchgears details and its calculations
34	As built documentation of the drawing / documents
35	DC Sizing Calculation
36	Exhaust and Ventilation
37	All the other required design Documents
<b>C. Civil Drawings</b>	
S. No	Drawing Title
1	Layout Plan For Control Building
2	RCC detail of Control Room Building
3	RCC detail of Outdoor Cable Trench including trench cover
4	GA & RCC detail of Transformer foundation & Oil Soak pit
5	GA & RCC detail of Auxiliary Transformer
6	GA & RCC detail of Capacitor Bank
7	GA & RCC detail of Burnt Oil Tank
8	GA & RCC detail of Lighting poles
9	GA & RCC detail of Equipment foundation
10	Structural Detail of Equipment
11	Overall layout plan indicating landscaping.
12	Detail of Fire wall
13	GA & RCC detail of NIFPS System
14	Detail of Water Supply and Sanitary system
15	GA & RCC detail of Septic Tank
16	Detail of Rainwater Harvesting System (detail of recharge pit)
17	GA & RCC detail of Underground Water Tank
18	GA and detail of fencing with gates of Switchyard, Capacitor Bank & Auxiliary Transformer
19	GA and Section of Road & Storm Water Drain
20	RCC detail of Security Gumtee
21	Outdoor Trench layout for switch yard
22	Sectional Details for Outdoor Trenches
23	Conduit plan for Control room building.
24	Switch yard layout

### 13.0 SUBMISSION OF DRAWINGS & OTHER DOCUMENTS

BOQ, Calculations and other documents etc. shall be on A4 size paper. All the drawings shall be drawn to the scale as far as possible on A3 size or larger size paper and should be legible. The drawings shall be submitted in colour copy. The submission shall be

- Three (03) Sets of drawings/BOQ/Calculation for Owners review and approval.
- Three (03) Sets of approved drawings/BOQ/Calculation for construction reference.

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- Six (06) Sets of final As Built drawings, design, BOQ, Calculation. O&M manual for all equipments supplied.
- Soft copies of all drawings/Documents/calculation in Auto CAD and Microsoft office file format as applicable.

Drawings shall be treated as submitted, only if provided with BOQ (If applicable). Transmittal sheet shall be mandatory to attach with all the drawing and documents. Format for transmittal shall be provided to successful bidder for drawing approvals etc.

### **14.0 TEST CERTIFICATES**

All equipments shall be tested as per their corresponding specification in Tender document.

All tests (Type test, Routine test, Acceptance test) shall be carried out at bidders cost. However prices against special test for equipments have to be quoted separately. Special test shall be Owners decision.

Type and Special test has to be carried out at CPRI/ERDA or as mentioned in specification. Routine, and Acceptance tests may be carried out at manufacturer's lab.

Bidder shall submit type test certificate of all the equipment with validity of five years (on the date of bid opening carried out at CPRI/ERDA).

### **15.0 QUALITY PLAN**

#### **15.1 Manufacturing Quality Plan**

Manufacturing Quality plan with respect to all major equipment and work has to be submitted by the successful bidder for following as a minimum:

- I. An outline of the proposed work and execution plan for approval.
- II. The structure of the supplier's organization for the contract
- III. The duties and responsibilities assigned to staff ensuring quality of work for the contract
- IV. Hold and notification points
- V. Submission of engineering documents required as per specification
- VI. The inspection of materials and components Inspection during fabrication /construction
- VII. Final inspection & tests

Successful bidder shall include submittal of bills invoice, Bill of lading, and factory test certificate for grade, physical tests, dimension, and specific watt loss per kg of core material to the purchaser for verification in quality plan suitably.

#### **14.2 Field Quality Plan**

- 14.2.1 Quality Assurance Plan for various stages of execution work shall be submitted by Contractor for approval of Owner. The plan should include the Organization structure so the Safety personnel to ensure the Manpower and Material safety during the entire duration of execution.
- 14.2.2 Environment, Health and Safety (EHS) shall be covered in the plan submitted by Contractor.
- 14.2.3 A checklist to ensure the quality of equipment installation shall be submitted by Contractor for approval

### **16.0 INSPECTION**

As per Chapter 40 (Training and Inspection) Volume - 1



### **17.0 TRAINING OF BRPL OFFICIALS**

As per Chapter 40 (Training and Inspection) Volume - 1

### **18.0 MONITORING OF MATERIAL DISPATCH STATUS**

Once the material is dispatched after Final clearance Transport Vehicle shall have GPS Tracking Device (Preferably Map My India Asset Tracking Device) and status of dispatch of material shall be sent to all the stake holders via SMS thru GPS Device. This shall be applicable to all the major equipments like GIS Panels, HT Panel, and Power Transformers, CRP and RTU.

### **19.0 OPERATION AND AFTER SALE SERVICES**

Contractor shall carry out all day to day operations of entire Substation after successful commissioning for a period of 6Months. Contractor shall assign 24x7 operating personnel for operation activities.

Contractor shall appoint appropriate after sale services staff for all necessary service requirements for a period of 6 Months. Contractor shall keep all necessary spares, tools & tackles, T& P, testing equipments for successful operation and maintenance requirement for said period.

Contractor shall provide after sale support for the tenure of stipulated time.

Responsibility of Contractor O&M Engineer shall include:

- a) Training of BRPL officials on successful operation of all the substation equipment including switchgears , Relays and SCADA.
- b) Operation and Maintenance of entire substation including all switchgears, Relays and SCADA.
- c) Refer Annexure-O for details

**TECHNICAL SPECIFICATION**  
**FOR**  
**CIVIL WORK**

<b>Prepared by</b>	<b>Amrita Singh</b>		<b>Rev: 0</b>
<b>Reviewed by</b>			<b>Date: 30<sup>th</sup> July, 2022</b>
<b>Approved by</b>	<b>Ajay Karan</b>		

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**1.0 GENERAL REQUIREMENT**

- 1.1. This chapter includes the technical requirements for 66kV Sub-station at Bakkarwala including associated design and preparation of all civil & structural drawings and execution of all associated civil works. This chapter deals mainly with technical specifications for the design, supervision and construction of complete civil & structural works.
- 1.2. The specifications are intended for general description of work, quality and workmanship. The specifications are not however exhaustive to cover minute details and the work shall be executed according to relevant latest Indian Standards / IRC specifications / CPWD specifications. In the absence of the above, the work shall be executed according to the best prevailing practices in the trade, recommendations of relevant American or British Standards or as per the instructions of Engineer. The IS standards / IRC specifications / CPWD specifications to be followed are mentioned in the technical specifications attached hereto. They shall be latest editions / version of the same. The Contractor is expected to get himself clarified on any doubts about the specifications, BOQ, etc. before bidding of the Tender.
- 1.3. The work shall be carried out according to the design / drawings to be developed by the Contractor and approved by the Owner based on Tender Drawings (tentative layout) supplied to the Contractor by the Owner. For all buildings, structures, foundations, etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the Sub-Station 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 purpose only. However, the Contractor shall quote according to the complete requirement.
- 1.4. The Contractor shall take all necessary precautions to protect all the existing equipment, structures, facilities & buildings, etc. from damage. In case any damage occurs due to the activities of the Contractor on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be made good by the Contractor at his own cost to the satisfaction of the Engineer. The Contractor shall also take all necessary safety measures, at his own cost, to avoid any harm / injury to his workers and staff from the equipment & facilities of the power station.
- 1.5. During the progress of work, the Engineer will exercise supervision of the work to ensure that the technical provisions of the contract are being followed and the work is being executed accurately and properly. However, such supervision shall in no way relieve the Contractor of the responsibility for executing the work in accordance with the specifications.
- 1.6. Before submitting the bid, the Contractor shall inspect and examine the site and its surroundings and shall satisfy himself as to the nature of the ground and subsoil, the availability of materials necessary for completion of the work, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.
- 1.7. In view of pandemic, the Contractor shall be bound to follow all guidelines issued by the Government & take all necessary arrangements & precautions for his workers & staff.

**2.0 GEOTECHNICAL INVESTIGATION**

The Owner has carried out Geo Technical Investigation and Topographical Survey for the entire Sub-Station including switchyard. The copy of the report is attached with the tender document as input to Contractor for Civil Design & Estimation Work.

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**3.0 SITE PREPARATION**

3.1. Scope

3.1.1. This clause covers the design and execution of the work and site preparation such as clearing of the site, the supply and compaction of fill material as per requirement upto desired formation levels, excavation and compaction of backfill for foundations, road construction, drainage, trenches, etc..

3.2. General

3.2.1. The layout and levels of all structures, etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks finalized / approved by the Owner. (The required filling up to formation level shall be in the scope of Vendor). The Contractor 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.

3.2.2. The Owner shall provide a boundary wall all around the plot with 02 entry gates. Contractor shall have to make good to all the damages to the boundary wall and gate during work execution, if occurs.

3.2.3. Contractor shall develop a building layout and other layouts so that if the trees are there inside the grid plot, they may be escaped from cutting. In extreme conditions when the tree cutting is unavoidable, necessary liaison for permission shall be on part of Contractor from respective Govt. Agency. Requisite formalities shall be carried out by Owner. Fee shall be borne by the Owner. Compensatory plantation shall be done (if required) by Contractor; BRPL shall provide space for the same.

3.2.4. The Contractor shall develop the site area to meet the requirements of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specification.

3.2.5. If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be designed to prevent the erosion by wind and water of material from its final compacted position or the in-situ position of undisturbed soil.

3.2.6. Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the Owner.

3.2.7. Backfill material around foundations or other works shall be suitable for the purpose for which it is used and shall be compacted to the density described under Compaction (clause 3.4 of this Specification). Excavated material not suitable or not required for backfill shall be disposed off by the Contractor in areas as directed by Owner upto a maximum lead of 5 km. Backfill material if found having mix of earth and fly ash should not be used for top 30 cm of formation level and should be supplemented with good earth at the cost of Contractor.

3.3. Excavation and Backfill

3.3.1. Excavation and backfill for foundations shall be in accordance with the relevant code.

3.3.2. Whenever water level is met during the excavation, it shall be dewatered and water level

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shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling. Nothing extra shall be payable by the Owner on this account.

- 3.3.3. 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 face shall measure not more than 1 m in height.
- 3.3.4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compaction of the material in successive uniform horizontal layers not exceeding 15 cm 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 10 cm in any direction shall not be placed in embankment adjacent to the structures.
- 3.3.5. 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**

- 3.4.1. The density to which fill materials shall be compacted shall be as per relevant IS code and as per direction of the Owner. All compacted sand filling shall be confined as far as possible. 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 a minimum of 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).
- 3.4.2. At all times unfinished construction shall have an adequate drainage system. Upon completion of the road surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.
- 3.4.3. 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**

- 3.5.1. 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 has to be approved by the Owner.

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**4.0 CODES AND STANDARDS**

All standards, specifications, acts and code of practice (latest revision) shall be followed. In case of conflict between this specification and those (IS standard / IRC specification / CPWD Specification, etc.) referred to herein, the former shall prevail.

**5.0 SUBMISSIONS**

The following documents shall be submitted by the Contractor for approval of the BRPL prior to commencement of fabrication and erection / construction.

This list is not exhaustive but indicative only. Final list of drawings shall be prepared by successful Contractor during detailed engineering.

- i. Design calculation, general arrangement drawings, foundation drawing & detailed erection / construction drawings including R/F drawings for Sub-Station Building.
- ii. Foundation design & drawing of all equipment & gantry foundations.
- iii. Structural steel fabrication drawings for gantry & equipment support structure.
- iv. Site preparation plan including filling up to formation level, etc.
- v. Foundation design & drawing of Power Transformer
- vi. Design & drawing of transformer grating & burnt oil tank
- vii. Foundation design & drawing for lighting pole (high mast, street pole, etc).
- viii. Foundation design & drawing for Capacitor Bank, Auxiliary Transformer and design of fencing for both.
- ix. Complete fencing along with gate for the Sub-Station yard
- x. Details of Indoor and Outdoor Cable Trenches with cable tray supports and trench covers
- xi. Design & drawing of Rainwater Harvesting System, sewerage system including septic tank, water supply arrangement, landscaping, etc.
- xii. Design & drawing of roads and complete drainage system (with final connection to Rain Water Harvesting recharge pit) within Sub-Station including crossings.
- xiii. Design & drawing of Security Room.
- xiv. Design & drawing NIFPS system & underground water tank.

**6.0 SUB-STATION BUILDING GENERAL REQUIREMENTS**

**6.1. General**

6.1.1. The scope includes the design, engineering and construction including anti-termite treatment, plinth protection, DPC of buildings including sanitary, water supply, electrification, fire fighting system, etc. The building shall be RCC framed structure of minimum concrete grade M25. The Sub-Station Building shall include rooms as specified below:

S. No.	Facility
i.	Control Room
ii.	Switchgear Room
iii.	Maintenance Room
iv.	Pantry
v.	Toilet

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vi. Staircase

**6.1.2. Site Service Conditions (considering main external road at 0.00 level)**

<b>S. No.</b>	<b>Particulars</b>	<b>Level</b>
1	Substation Road level	+750 mm
2	Final top level of gravel in outdoor yard	+750 mm
3	Final top level of Equipment & gantry foundation	+1050 mm
4	Control Room Building Plinth Level	+1500 mm

6.1.3. Minimum floor area requirements have been given in tender drawings, which may be increased at the time of detailed engineering to suit project requirements.

6.1.4. Building architecture plan shown in tender drawing is tentative & shall be reviewed during detailed engineering.

6.1.5. An open space of 1200 mm 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.

6.1.6. The building shall be aesthetically designed keeping in view the surrounding landscape; proper architecture shall be used to design the exterior look and finish. The architectural drawing shall be submitted for Owner's approval.

6.1.7. Future extension of one floor shall be considered at the time of design. Any other possibility of annex building shall be taken care of while finalizing the layout of the Substation building.

6.1.8. Provision should be made for future expansion of the building in horizontal direction, wherever it is feasible.

6.1.9. Substation building shall be constructed as per the approved drawings by Owner. CPWD specification shall be followed in all the building works. The clear height of building shall be minimum 4.5 m (from floor level to bottom of roof slab of ground floor).

6.1.10. Any other work not mentioned in this specification but required for the successful completion of the work shall be considered in the scope of work.

**6.2. Design**

a) The building shall be designed on Green Building Concept. The design of Control Room building shall be such decided that's minimum one floor can be added in future.

Following parameters shall be followed: -

- To follow & fulfill the requirements of the National Building Code of India and the standards quoted therein.

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- The specified climatic & loading conditions shall be considered.
  - The building shall have RCC framed super structure.
  - 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.
  - To meet functional and economical space arrangement for maximum utilization of the building.
  - To be aesthetically pleasing with uniformity and consistency in architectural design.
  - To allow for easy access to equipment for their maintenance.
- 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) The building lighting shall be designed in accordance with the requirements of relevant section.
- f) The building shall have at least two entry/exits gates.

**6.3. 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: 875 (latest revision). 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 (latest revision). Seismic Coefficient method shall be used for the seismic analysis as per IS: 1893 (latest revision) 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 the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the 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 live loads & equipment loads. 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.



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For consideration of loads on structures IS: 875 (latest revision), the following minimum superimposed live loads shall however be considered for the design.

Roof	2.5 KN/M2 0.75 KN/M2	for accessible roofs for in-accessible roofs
RCC-Floor	(i) 5 KN/M2 (ii) 15 KN/M2 (min)	for offices, for equipment for floors or actual requirement if higher than 15 KN/M2 based on equipment weight and layout plan
Stairs & balconies	5 KN/M2	
Toilet Rooms	2 KN/M2	

Any additional load coming in the structure shall be calculated as per IS: 875 (latest revision).

**6.4. Submission**

The following information shall be submitted for review and approval to the Owner:

- a) 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.
- b) Structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.
- c) 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.
- d) 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.
- e) Product information of building components and materials, including walls partitions, flooring, ceiling, roofing, door and windows and building finishes.
- f) A detailed schedule of building finishes including colour schemes.
- g) A door & window schedule showing door types and locations, door lock sets, latch sets and other door hardware.
- h) Copy of all tests/ studies/ investigation carried out by bidder as per scope.

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Approval of the above information shall be obtained before ordering materials or starting fabrication or construction activity.

6.5. Flooring

Flooring in various rooms of control room building shall be as per detailed schedules given in Table – 1. Pantry countertop shall be of granite stone of required specification as per direction of Engineer-In-Charge. Grade slab shall be constructed before flooring.

6.6. Walls

Control room building shall be of framed superstructure. All walls shall be non-load bearing walls. Minimum thickness of walls shall be 340 mm upto DPC level in cement mortar 1:6 (1 Cement: 6 Coarse sand) and 230 mm above DPC level in cement mortar 1:4 (1 Cement: 4 Coarse sand).

6.7. Plastering

All internal walls shall have minimum 12 mm / 15 mm thick 1:4 (1 Cement: 4 Coarse Sand) cement sand plaster. The ceiling shall have 6 mm thick 1:3 cement sand plaster.

6.8. Finishing

All external surfaces (control room building and boundary wall) shall have stone grit/ Marble Chips with colour pigment (with groves formed) (item no.13.72-DSR 2021) finish over 12 mm thick cement sand plaster 1:4 (1 Cement: 4 coarse sand) mixed with water proofing compound in the ratio as recommended by the manufacturer. Suitable pigment shall be added to render the surface aesthetically pleasing as per directions of Engineer-in-charge.

6.9. Door & Window

The detail of doors and windows of Substation building is as follows:

- a) All entrance/ external doors including SGR room & Control room will be 2 hours fire rated doors.
- b) The detail for all other doors & windows shall as per finishing schedule Table-1 attached at the end of this Technical Specification.
- c) Floor springs and hydraulic door closer of ozone make or equivalent to be provided.
- d) To maintain proper size of opening for doors & windows, Contractor shall provide rough round aluminium tube of size 40 x 20 mm around all opening before plaster work.
- e) The Contractor shall provide a door and window sill of granite stone of size 18-20 mm.

6.10. Partition

Partition made of powder coated aluminum frame provided with 12.0 mm thick toughened glass shall be installed at locations as per requirement/ direction of Engineer in Charge.

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6.11. Plumbing & Sanitation

Two toilets (male & female) have to be provided. Suitable size of pantry with arrangement for water cooler is to be made.

- a) All plumbing and sanitation works 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 Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.
- b) PVC sintex or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 2 Nos. 1000 litre capacity shall be provided.
- c) Chlorinated Polyvinyl- chloride (CPVC) pipe shall be used for internal & external piping work for potable water supply.
- d) Unplasticised rigid PVC pipes for all sanitary works.
- e) All sanitary fittings shall be of Hindware / Parryware / Cera.
- f) Each toilet shall have minimum fittings
  - i) Water closet (European type W.C. pan) 390 mm high (item no. 17.3.1- DSR 2021) with all fittings shall be provided.
  - ii) Half Stall Urinal (580 x 380 x 350 mm) with all fittings (item no. 17.5.2- DSR-2021).
  - iii) Wash basin (630 x 450 mm) with all fittings (item no. 17.7.1- DSR 2021).
  - iv) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing (item no. 17.31- DSR 2021).
  - v) CP brass towel rail (600 x 20 mm) with C. P. brass brackets.
  - vi) Soap holder and liquid soap dispenser.
- g) Water cooler for drinking water with adequate water storage facility shall be provided and located in Pantry / as directed by Engineer In Charge.
- h) 1 No stainless steel A ISI 304(18/8) kitchen sink as per IS 13893 with Drain board (510 x 1040 x 225 mm bowl depth for pantry shall be provided complete with all fittings (item no. 17.10.1.2-DSR 2021).
- i) All fittings, fastener, grating shall be brass chromium plated.
- j) All sanitary fixtures and fittings bought to site must bear identification marks of the Manufacturer.
- k) Suitable size and load minimum 6 kg pressure unplasticised PVC pipe to be used for soil, waste and drain pipes for underground works for areas not subject to traffic load.

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**7.0 STORM WATER DRAINAGE FOR CONTROL ROOM BUILDING**

Drains shall be provided all around the building for the collection of storm water from the roof of the building. This water shall be collected in chambers and these chambers shall drain to the main drainage system of the station which shall in turn be connected to rain water harvesting recharge pits.

Unplasticised Rigid PVC rain water down comers (150 dia) conforming to IS: 13592 Type A, including jointing with seal ring conforming to IS: 5382, leaving 10 mm gap for thermal expansion shall be provided to drain off the rain water from the roof.

All external drains shall be covered with precast perforated RCC covers (50 mm thk & with angle frame of 50 x 50 x6) of suitable size and thickness.

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.

**8.0 DEVELOPMENT OF YARD**

**8.1. Scope**

8.1.1. The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specifications and direction of the Owner.

8.1.2. Stone spreading shall be done in the Outdoor Sub-Station Yard area, Power Transformer, Capacitor Bank and wherever equipment and structures are to be provided under the present scope of work.

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.

Test for aggregates should be as follows:

a) Sieve Analysis limits (Gradation)

As per IS: 383-1970

The material to be used for stone filling / site surfacing shall be uncrushed / crushed / broken stone of 20 mm nominal size (ungraded single size) conforming to Table 2 of IS:383 - 1970.

Sieve Analysis (Gradation):  
(IS: 383 - Table - 2)

Sieve size	% passing by weight
40mm	100
20mm	85-100
10mm	0 – 20

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4.75mm 0-5

One test shall be conducted for every 50 cum.

b) Hardness:

Abrasion value (IS: 2386 Part-IV) - not more than 40%

Impact value (IS: 2386 Part-IV) - not more than 30% and frequency shall be one test per 50 cum with a minimum of one test per source

c) Flakiness Index

As per IS: 2386 Part I

- 8.1.3. Before taking up the final yard treatment, antiweed treatment shall be applied in the switchyard area wherever yard treatment is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department shall be sought wherever feasible while choosing the type of chemical to be used. Nevertheless the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10 M x 10 M (approx.) and monitored over a period of two to three weeks by the Engineer-in-Charge. The final approval shall be given by Engineer-in-Charge based on the results.
- 8.1.4. The antiweed chemical shall be procured from reputed manufacturers. The dosage and application of chemical shall be strictly followed as per manufacturer's recommendation. The contractor 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 antiweed chemicals
- 8.1.5. After all the structures/equipment are erected and antiweed treatment is complete, the surface of the substation area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-Charge. De-weeding including removal of roots shall be done before rolling is commenced. Engineer-in-Charge shall decide final formation level so as to ensure that the site appears uniform free from undulations. The final formation level shall however be very close to the formation level using manual or machine roller with suitable water sprinkling arrangement to form a smooth and compact surface.
- 8.1.6. After antiweed treatment & compaction of earth, final yard treatment shall be carried out in the 3 layers as follows:
- a. Providing and laying in position 75 mm thick base layer of cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 brick aggregate 40mm nominal size).
  - b. Flat brick flooring with over burnt bricks /class designation 100 as per approval of BRPL on the bed of 12 mm thick cement mortar 1:6 (1 cement: 6 coarse sand) and filling the joints 12 mm thick all around the bricks with same mortar.
  - c. Over the flat brick flooring, a final surface course of minimum 100 mm thickness of 20 mm nominal size (single size ungraded) broken stone shall be spread and uniformly leveled.
- 8.1.7. 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

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equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation, structure or equipment during rolling/compaction.

- 8.1.8. The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

### **9.0 SUB-STATION TRENCHES**

- 9.1. The cable trenches and precast removable RCC cover (with lifting arrangement) shall be constructed using RCC of minimum grade M25.
- 9.2. The cable trench wall shall be designed for the following loads.
- Dead load of 155 kg/m length of cable support + 75 Kg on one tier at the end.
  - Triangular earth pressure + uniform surcharge pressure of 2T/m<sup>2</sup>.
- 9.3. Trench bed will be 25 mm thick with 12.5 mm nominal size stone aggregate finished with a floating coat of neat cement including cement slurry.
- 9.4. Cable trench covers shall be of minimum 50 mm thick or as per design. All trench covers shall have desired reinforcement welded to M.S. frame of angle 50 x 50 x 6 mm all round the cover. Size of covers shall be as per site requirement / direction of Engineer In Charge.
- 9.5. All cable trenches inside the buildings shall have covers comprising of 6 mm thick chequered plates fixed on angle 40 x 40 x 5 mm frame with arrangement of MS holes for lifting of cover.
- 9.6. 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.
- 9.7. Trenches shall have proper slope. Necessary sumps to be constructed and automatic sump pumps of minimum 2.0 HP capacity of approved make with complete electrical fittings shall be installed. Cable trenches shall not be used as storm water drains.
- 9.8. The top of cable trench shall be such that the surface rain water does not enter the trench.
- 9.9. The trench bed shall be perpendicular to the run. Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
- 9.10. The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.
- 9.11. 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.

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- 9.12. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm/15 mm thick 1:4 cement sand mortar.
- 9.13. Provision of sump and pump is to be done for disposal of rain water from trench.

### **10.0 SUB-STATION DRAINAGE SYSTEM**

Adequate site drainage system shall be provided by the Contractor. The Contractor shall design the storm water drainage system covering all culverts, ditches, drains, etc. The run off shall be calculated on the basis of maximum rainfall intensity 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. Outfall of drainage shall be suitably connected to rainwater harvesting recharge pits. While designing the drainage system following points shall be taken care of:

1. 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.
2. For design of RCC pipes for drains and culverts, IS: 456 and IS: 783 shall be followed.
3. The Contractor 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.
4. 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 30 m interval, at connection points and at every change of alignment.
5. Pipe drains shall be connected through manholes at an interval of maximum 30 m.
6. All internal site drainage system, including the final connection/disposal to rainwater harvesting recharge pits shall be part of Contractor's scope including all required civil work, mechanical & electrical systems. The Contractor shall connect drain(s) at one or more points to rainwater harvesting recharge pits as feasible at site. The drainage layout of the substation shall be approved by the Owner & all works shall be carried out by the Contractor.
7. The drainage scheme and associated drawings shall be got approved from the Owner.

### **11.0 SUB-STATION ROAD**

- 11.1. Inside substation roads to be provided with accessibility for open parking, if adequate space is available in the grid layout. Building and parking are in the scope of bidder. Layout of the roads shall be based on layout drawing for the substation. Parking areas shall be provided for Site personnel and visitors as per layout drawing. Adequate turning space for vehicles shall be provided and bend radius shall be set accordingly. It has to be connected suitably with roads.
- 11.2. All substation roads shall be constructed so as to permit transportation of all heavy equipment upto 60 MT. The main approach roads upto Control Room Building and other relevant roads will be RCC Roads (M25 grade with ready mixed concrete from batching plant. The ready mixed concrete shall be

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laid and finished with screed board vibrator, vacuum dewatering process and finally finished by floating, brooming with wire brush, etc. complete as per specifications and directions of Engineer In Charge). The other connecting roads and pathways shall be of Paver blocks/ CC Road as per site requirement. The pavers blocks used for the roads shall be M-35 grade 60 mm thick cement concrete pavers manufactured by PLC based automated block/paver making machine having compression and vibration both in sequence using multi cavity precision steel moulds.

- 11.3. Design of road shall be as per IRC standard.
- 11.4. Adequate provision shall be made for road drainage.
- 11.5. All the culverts and its allied structure (required for road/rail, drain, trench crossings, etc.) shall be designed for class AA loading as per IRC standard/IS code. All trenches inside the substation shall cross the road through culverts.
- 11.6. Balance areas not covered by building, switchyard and road shall be Cement Concrete / Paver blocks.

**12.0 TRANSFORMER FOUNDATION, RAIL TRACK/ ROAD CUM RAIL TRACK**

- 12.1. Transformer foundation shall be designed for 31.5 MVA transformer. The OEM drawing for the same shall be shared during detailed engineering.
- 12.2. The Contractor shall construct a proper approach to the power transformer foundation. The approach system shall be suitable to permit the movement of any failed unit fully assembled with integral radiators and oil without the de-energization of any other equipment in the station. This system shall enable the removal of any failed unit from its foundation to a repair area and the installation of the spare unit. This system, preferably, shall not interfere with the normal internal road and trench system. If trench/ drain crossings are required then suitable RCC culverts shall be provided in accordance with I.R.C Code/ relevant IS.
- 12.3. The rails shall be of first quality 52 kg/m medium manganese steel as per Indian Railway specification T-12-64 and its subsequent revision, joined together by fish plates as per Indian Railway specification T-1/57 and their drawing no. 090M and 27 mm diameter fish bolts. No joint shall be provided at less than L/3 of the longest part.
- 12.4. The grating shall be made of MS flat of size 50 mm x 5 mm placed at 30 mm center to center and 25 mm x 5mm MS flat at a pacing of 150 mm at right angle to each other with all around frame of MS angle 50 x 50 x 5 mm. Maximum length of grating shall be 1500 mm and width shall not be more than 500 mm. The gratings supported on ISMB 150 mm shall be placed at the formation level and will be covered with 100 mm thick layer of broken/crushed/non-crushed stone having size 20 mm to 40 mm which acts as an extinguisher for flaming oil.

**13.0 TRANSFORMER OIL PIT & BURNT OIL TANK**

- 13.1. Size of Transformer oil pit will be in accordance with 31.5 MVA transformer. OEM drawing of the transformer shall be provided during detailed engineering.
- 13.2. All transformers shall have oil collection pit (transformer oil pit) connected to burnt oil tank.
- 13.3. Each transformer including oil conservator tank, cooler banks, etc. shall fall within the periphery of the transformer pit (pit walls) constructed around the transformer foundation. The clear distance of the



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retaining wall from the transformer shall be 20% of the transformer height or 0.8m whichever is more. The transformer pit thus formed shall have a capacity equal to volume of oil in the transformers. The MS grating placed at the formation level shall be covered with 100mm thick gravel of 40mm nominal size which acts as an extinguisher for flaming oil.

- 13.4. Each transformer pit shall be drained towards a burnt oil tank whose role is to recover the infiltrating water and the drained oil from the pit. The burnt oil tank shall have sufficient capacity to receive without overflowing the oil content of the larger transformer (oil capacity of 31.5 MVA transformer) plus the water content of any fixed fire fighting system and a certain quantity of rain water collected from the pit connected to it. The system shall be provided with air vents large enough to avoid over pressure during operation. The whole internal surface of the burnt oil tank should be impermeable.
- 13.5. The walls which make up the transformer pit shall be made of fire resistant material such as reinforced cement concrete, etc and shall be impervious to oil.
- 13.6. The floor of the transformer pit shall be of plain cement concrete of grade M15.
- 13.7. The final finish of walls & floor of transformer pit shall be with cement plaster & neat cement punning.
- 13.8. Pump house with minimum 2.0 HP capacity & of approved make with electrical fittings of ISI mark shall be supplied and installed by the Contractor to evacuate the fire fighting & rainwater from the burnt oil tank.
- 13.9. If the height of the retaining wall which form the transformer pit exceed 60cm, steps shall be provided to facilitate access to the transformer and its ancillaries.
- 13.10. When designing the transformer pit, the movement of the transformer must be taken into account.

**14.0 FIRE PROTECTION WALLS**

- 14.1. General
  - 14.1.1. Fire protection walls shall be provided, if required, in accordance with Tariff Advisory Committee (TAC) recommendations.
- 14.2. Material
  - 14.2.1. The firewall may be made of reinforced cement concrete (M-25 grade) as per the system requirements. Materials used must conform to the standards of the National Fire Prevention Association & TAC Norms.
- 14.3. Fire Resistance
  - 14.3.1. The firewall shall have a minimum fire resistance of 3 hours. The walls of the building which are used as firewalls shall also have a minimum fire resistance of 3 hours.
  - 14.3.2. The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.
- 14.4. Dimensions

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- 14.4.1. Dimension will be according to 31.5 MVA transformer will be provided during detailed engineering.
- 14.4.2. The height of firewall shall be minimum 6 m and shall extend at least 300 mm above the topmost part of the transformer and length wise 600 mm beyond the transformer (on both sides) including any radiators and tap changer enclosure.
- 14.4.3. These dimensions might be reduced in special cases, as per the approval of Owner where there is a lack of space.
- 14.4.4. The building walls which act as firewalls shall extend at least 1 m above the roof in order to protect it.

**15.0 DESIGN CONSIDERATION FOR FOUNDATION**

15.1. General

- 15.1.1. Scope of Work 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, Power transformer/Reactors, NIFPS system, marshalling kiosks, auxiliary equipment, tanks or any other equipment foundations required to complete the work.
- 15.1.2. Concrete shall conform to the requirements mentioned in IS: 456 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 M25 concrete shall be used for all structural/load bearing members as per IS: 456 (latest revision).
- 15.1.3. 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.
- 15.1.4. The top of switchyard equipment foundations shall be minimum 300 mm above finished yard level.
- 15.1.5. Minimum 75 mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.
- 15.1.6. Concrete made with Portland cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.
- 15.1.7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footing or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.
- 15.1.8. If pile foundations are adopted, the same shall be cast-in-situ driven/bored or precast or under reamed type as per relevant parts of IS: 2911. In every condition only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be

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carried out by the bidder at their cost to establish the piles design capacity. The Contractor shall take up the job of piling only after the design capacities of piles have been established. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion. The contractor shall go for vertical load testing, lateral load testing & pullout load testing. The contractor may choose static or dynamic load testing upon site condition and time constraint.

15.2. Design

- 15.2.1. All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS: 456 and minimum grade of concrete shall be M-25.
- 15.2.2. Limit state method of design shall be adopted unless specified otherwise in the specification.
- 15.2.3. For detailing of reinforcement IS: 2502 and SP: 16 shall be followed. TMT bars conforming to IS: 1786 shall be used as reinforcement. However, in specific areas mild steel (Grade I) conforming to IS: 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall having thickness of 150 mm and above. For footings minimum cover shall be 50 mm.
- 15.2.4. RCC water retaining structures like storage tanks, etc. shall be designed as uncracked 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.
- 15.2.5. 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. Detailed design calculations shall be submitted by the bidder showing complete detail of piles/pile groups proposed to be used.
- 15.2.6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.
- 15.2.7. Necessary protection to the foundation work if required shall be provided to take care of any special requirement for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental / harmful to the concrete foundations.
- 15.2.8. RCC columns shall be provided with rigid connection at the base.
- 15.2.9. All sub-structures shall be checked for sliding and overturning stability during construction as well as operation for various combinations of loads. Factor of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in this Specification. 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.
- 15.2.10. Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest. Co-efficient of active or passive earth pressure (whichever is applicable).

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However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

- 15.2.11. In addition to earth pressure, ground water pressure, etc., a surcharge load of 2T/ Square metre shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure, etc, for taking in account the vehicular traffic in the vicinity of the structure.
- 15.2.12. Following conditions shall be considered for the design of water tank in pumps 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 and 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.
- 15.2.13. Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum groundwater table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.
- 15.2.14. 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.
- 15.2.15. The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.
- 15.2.16. The 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.

**15.3. Admixture & Additives**

- 15.3.1. Only approved admixtures shall be used in the concrete for the Civil Work. 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.
- 15.3.2. Admixtures in concrete shall conform to IS: 9103. The waterproofing cement additives shall conform to IS: 2645. Owner shall approve concrete Admixtures/ Additives.

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- 15.3.3. The contractor may propose and the Owner may improve 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 operation and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.
- 15.3.4. The water-reducing set-retarding admixture shall be of an approved brand.
- 15.3.5. The waterproofing cement additives shall be used as required/advised by the Owner.
- 15.3.6. Water proofing treatment on roof shall be as per Item No 22.7 - DSR 2021.

**16.0 FENCING OF SUB-STATION (LIVE PART) AREA**

16.1. General

Fencing shall be designed for the most critical loading combination taking care of wind force, stability, tension on wires, minimum requirements as per this clause for are materials IS 8910 and fabrication IS 800 as per recommendations

16.2. Areas Requiring Fencing

16.3. Fencing shall be providing for the following areas:

- 16.3.1. Site fencing for the complete Outdoor substation Yard area including Power transformer area. Gates shall be provided for men and machine / equipment to be taken out of the substation.
- 16.3.2. The IRC weld mesh panels fencing of Capacitor Bank with roof cover (as per approved BRPL pattern) if required.
- 16.3.3. Fencing of Aux. Substation Transformer (as per approved BRPL pattern).

16.4. Product Material

16.4.1. The minimum requirements are as follows:

IRC Weld Mesh fencing in accordance to relevant IS Code

- Size of IRC mesh 25X75 mm
- Nominal wire size 6 gauge/ 7.75 kg/m<sup>2</sup>
- Width of fencing panel 2400 mm
- Height of fencing 2000 mm
- Fabrication of panels 40 mm Nominal bore M.S. Pipe (medium duty). Providing elbow/bend at corners & 40 x 5 mm M.S. flats in beading
- Paint shall be painted with a coat of appropriate primer and two or more coats of epoxy paint

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16.4.2. Posts

- Intermediate Straining Post : 65 mm Nominal bore, M.S. Pipe (Medium duty)
- Base Plate : 12 mm M.S. Plate with 4 nos of hole. Nuts & bolts of suitable diameter.
- Paint : shall be painted with a coat of appropriate primer and two or more coats of epoxy paint

The IRC weld mesh Panels shall be fixed to the post at the top and bottom of the 65 mm Nominal bore, M.S. Pipe by Nuts and bolts. The Intermediate straining Posts to be erected by using holding down bolts and nuts grouted in toe wall around the Yard (the height of Yard Toe wall to be at least 450 mm above the yard level and upto 340 mm wide).

16.5. Installation

- 16.5.1. Fence shall be installed along switchyard line.
- 16.5.2. Post holes shall be excavated by approved methods.
- 16.5.3. Intermediate posts shall be spaced 2.5 m apart measured parallel to ground surface.
- 16.5.4. Posts shall be set in 1:2:4 plain cement concrete blocks of minimum dimension (340 mm x 340 mm x 750 mm deep) Concrete work shall conform to relevant clause. Post shall be braced and held in plumb position and true alignment and elevation until concrete has set.
- 16.5.5. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.
- 16.5.6. Bottom and top of the fence panels shall be fixed with post by MS flats of 50 mm x 6 mm (min).
- 16.5.7. Toe wall of Brick masonry over 75 mm thick PCC (1:4:8 ) shall be provided below all fencing and shall be minimum 400 mm above and 450 mm below finished ground level. 50 mm thick coping (M15) to be provided over brick wall. All exposed surfaces of brick toe wall shall be provided with 1:4 cement sand plaster (1 cement: 4 coarse sand) and finished with grit wash.

16.6. M.S. Gate

- 16.6.1. M.S. Gate of 6.0 m wide x 2.3 m height (2 nos) and 1.55 m x 2.3 m height (1 no) shall be provided to provide access through the fencing to the yard. M.S. Gate of 6.0 m wide x 2.3 m height shall be made in two leaf and 1.55 m x 2.3 m height shall be made in one leaf with locking arrangements. The gate shall be made with outer frame of 40 NB (Medium) M. S. Pipe. Weld mesh of opening size 25 x 75 mm and nominal wire size of mesh is 6 gauge/ 7.75 kg/m<sup>2</sup> (as per standard approved drawing of BSES).
- 16.6.2. Hinges, al-drops and other accessories shall be provided for effective working of the gate.

**17.0 GATES**

- 17.1. The main gates in boundary wall shall be provided as per BRPL approved standard design / drawing. Make of MS materials shall be Sail/ Jindal/ TATA.

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- 17.2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one or more coat of approved steel primer and two coats of synthetic enamel paint.
- 17.3. Gates shall be fitted with approved quality iron hinges. Hinges shall permit gates to swing through 180 degree.
- 17.4. Double gates shall be fitted with centre rest and drop bolt to secure gates in closed position.
- 17.5. Main Gate shall be 6m wide. Gates shall be installed in locations shown on drawings. As per availability of space, next to the main gate, a men gate (1.25 m wide, single leaf) shall also be provided as a wicket gate otherwise wicket gate shall be provided within the larger gate.
- 17.6. Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism shall be fitted as per site requirement.
- 17.7. The gates shall be provided with suitable locking arrangement.
- 17.8. The gate shall be painted with a coat of appropriate primer and two or more coats of epoxy paint

**18.0 MISCELLANEOUS GENERAL REQUIREMENTS**

- 18.1. Bricks having minimum 100 kg/cm<sup>2</sup> compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 100 kg/cm<sup>2</sup> compressive strength before submitting his offer.
- 18.2. Doors and windows on external walls of the building (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade over the openings with 150 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 600 mm over window & door openings.
- 18.3. RCC staircase shall be provided for access to roof of the entire building. All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm Minimum width of stairs shall be 1500 mm. Steel doors shall be provided in the Mumty and height of Mumty should be 2.6m.
- 18.4. Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.
- 18.5. The railing of staircase shall be 0.9 m average height comprising of 20 mm square bars of length 1.05 m and 150 mm centre to centre with teak wood handrail on top of railing including fixing of vertical bars in steps by grouting of required hold fast as per direction of Engineer in Charge.
- 18.6. All buildings shall have 750 mm wide plinth protection all round.
- 18.7. 25-30 mm thick kota stone to be provided at plinth level as DPC.
- 18.8. BSES Display board with LED lighting arrangement is to be provided of required size and as per approved pattern /drawing of BRPL with name of the grid.

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- 18.9. Water and Sewer line connections to be done with running line of CIVIC agency, if approval of CIVIC agency is available
- 18.10. 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.

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 lighting fixtures, fixing of supports/ embedment, provision of cutouts, etc for indoor illumination, ventilation & Air conditioning shall be the sole responsibility of the Contractor. 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 FIELD QUALITY PLAN FOR CIVIL WORKS**

The field quality plan for all civil works shall be in accordance with CPWD specification and other relevant Indian Standard Codes. All quality checks and procedures shall be followed as per relevant CPWD norms.

**21.0 WATER SUPPLY**

- 21.1. Arrangement of water for construction work as well as drinking purpose shall be in the scope of Contractor.
- 21.2. The Contractor shall carry out all the plumbing/erection works required for supply of water in Substation building.
- 21.3. A scheme shall be prepared by the Contractor indicating the layout and details of water supply which shall be got approved from the Owner before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works.
- 21.4. Pumps for water supply shall be in the scope of contractor. The Contractor shall provide an underground water reservoir, near the gate of minimum 20 M<sup>3</sup> capacity. Pump house for pumping water from underground water tank to the overhead water tank on top of the building shall be of minimum 2.0 HP capacity & electrical fittings of ISI mark.
- 21.5. The details of tanks, pipes, fittings, fixtures etc for water supply shall be approved by engineer in charge.

**22.0 SEWERAGE SYSTEM**

- 22.1. Sewerage system shall be provided for control room building.
- 22.2. The Contractor shall construct septic tank and soak pit suitable for 20 users or make connection with nearby existing sewerage system of Civic agency, if approval of Civic agency is available



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- 22.3. The system shall be designed as per relevant IS Codes.
- 22.4. External sewerage system including connection with internal services of building shall be within the scope of this contract. The connection and laying of sewer lines and manholes upto the point of connection with the sewer line of local civic agency if existing within 100 m from any point of boundary of sub-station. If the sewer line of local civic agency does not exist in the area then septic tank with soak pit shall be constructed for control room building (suitable for 20 users). BRPL shall obtain necessary approval from civic agency for laying of sewer lines as aforesaid and connection thereof. Any municipal charges for approval and connection shall be paid by BRPL directly to the local authorities.

### **23.0 RAIN WATER HARVESTING**

- (a) Providing recharge structures with bore wells at different locations as per approved drawing for rainwater harvesting system. The number of recharge structures will depend on the discharge quantity. The recharge structures shall be suitably located within the sub-station. Branch drains from the main drain carrying rainwater from entire switchyard, constructed in accordance with clause 9 & 10 shall be connected to the recharge structures. Each recharge structure will be as per description given below.
- (b) The internal diameter of recharge shafts shall be 4.5 meter with 230 mm thick lining of brick work upto a depth of 2.0 meter from ground level and 345 mm thick brickwork below 2.0 meter depth. The brickwork shall be constructed with cement mortar 1:6 (1cement: 6 coarse sand). The overall depth of shaft shall be 5.0 meter below invert level of drain. The shaft shall be covered with RCC slab for a live load of 300 kg per sqm. Two openings of size 0.7 x 0.7 meter shall be provided in the RCC cover slab. An iron cover made of 5 mm thick chequered plate with hinges shall be provided on the openings. Galvanized M.S. rungs of 16 mm diameter at spacing of 300 mm shall be provided in the wall of shaft below the opening in the RCC slab to facilitate cleaning of shaft.
- (c) A 300 mm diameter bore well shall be drilled in the centre of the shaft. The depth of bore well shall be 5.0 meter more than the depth of sub soil water.
- (d) A 150 mm diameter unplasticised rigid PVC pipe conforming to IS: 1161 shall be lowered in the bore well keeping bail plug towards bottom of bore well. The pipe shall have 1.58 mm holes for 4.0 meter length starting from 1.0 meter from bottom of bore well. Holes of 3.0 mm diameter shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and down wards. The overall length of pipe shall be equal to total depth of bore well plus depth of shaft.
- (e) Gravel of size 3 mm to 6 mm shall be filled around 100 diameter MS pipe in the bore well. The shaft shall be filled with 500 mm thick layers each from the bottom of shaft with boulders of size 50 mm to 150 mm, gravel of size 5 mm to 10 mm, coarse sand having particle size 1.5 mm to 2.0 mm and boulders of size not less than 200 mm respectively.
- (f) Drawing based on above details of recharge structure for rainwater harvesting has to be prepared by contractor and to be approved from engineer in charge.

### **24.0 STATUTORY RULES**

- 24.1. Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable far the State), Fire Safety Rules of Tariff Advisory Committee. Water Act for pollution control, Energy

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Conservation Act, etc.

- 24.2. Statutory clearance and norms of State Pollution Control Board shall be followed.
- 24.3. 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.
- 24.4. 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-I).
- 24.5. Construction joints shall be as per IS: 456.
- 24.6. All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.
- 24.7. All tests as required in the standard field quality plans of CPWD or as per sound engineering practices have to be carried out.
- 24.8. The type and treatment of all foundation shall be as per recommendation of geo-technical investigation reports.

**25.0 TESTS FOR MATERIAL / WORKMANSHIP**

All tests required for various bought out items, materials, quality of workmanship or any other tests as desired by Project Manager and as specified in technical specification shall be carried out by the Bidder at his own cost in the presence of the authorized representative of the Engineer.

The Bidder shall submit comprehensive Quality Assurance plan for all materials, equipment, workmanship, services etc. and get it approved from the Engineer. This shall include setting up a test laboratory at site. However, such check list shall in no way limit the liability and responsibility of the Bidder in regard to quality of workmanship as detailed out in the specifications.

The sampling & testing of the construction materials shall be in accordance to latest CPWD Specifications related to all activities of the building and other civil construction works.

**26.0 DRAWINGS**

The successful Bidder shall first submit the structural design calculations along with general arrangement drawings for approval. After the approval of the design calculations by the owner detailed construction drawings shall be prepared and submitted for Employer's approval along with revised design calculations if required within 7 days. Required number of sets of design calculations, drawings and documents shall be submitted by the Bidder.

Calculations and other documents etc. shall be on A4 size paper. All the drawings shall be drawn to the scale as far as possible on A1 size or larger size paper and should be legible. The submission shall be

- Three (03) Sets of approved and released for construction drawings/Calculation for Owners reference.

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- Two (02) Sets of final As Built drawings, design, Calculation & O&M manual for all equipments supplied.
- Soft copies of all drawings/Documents/calculation in Auto CAD and Microsoft office file format as applicable.

Transmittal sheet shall be mandatory to attach with all the drawing and documents. Format for transmittal shall be provided to successful bidder for drawing approvals etc.

### **27.0 ALTERATION IN SPECIFICATION AND DESIGN**

The Project Manager shall have the power to make any alteration and omissions from, additions to or substitution for the original specifications, drawings, designs and instructions that may appear to him to be necessary during the progress of the work and the Bidder shall carry out the work in accordance with any instruction which may be given to him in writing signed by the Project Manager and such alterations, omissions, additions or substitutions shall not invalidate the contract. Any altered, added or substituted work which the Bidder may be directed to do in the manner above specified as part of the work shall be carried out by the Bidder on the same conditions in all respects on which the Bidder agreed to do the original contract work. The time for completion of work shall be altered in the proportion that the altered, added or substituted work bears to the original contract work and the certificate of the Project Manager shall be conclusive as to such proportion.

The rates for the altered items of work shall be worked out on the following basis and necessary alternations in the total amount shall be made on that basis:

- (a) The rates to be reimbursed or recovered shall be taken as same as those given in CPWD-DSR (latest) for those items for which the rates are available in CPWD - DSR (latest). However, the premium as officially declared by CPWD's official circulars, at the time of carrying out these works, the same shall also be applicable.
- (b) Rates for the items not covered under CPWD - DSR (latest) shall be derived from the rates of similar items of CPWD schedule of rates. However, the premium as officially declared by CPWD on the above DSR rates if existing or prevalent through CPWD's official circulars, at the time of carrying out these works, the same shall be applicable.
- (c) In the event there is no similar class of work specified in the CPWD - DSR (latest), the Bidder shall work on a rate for such an item on the basis of the prevalent market rates for materials / men / machines and submit the same together with the detailed analysis to the Project Manager within 7 days. The Project Manager shall thereafter review the correctness and then forward to BRPL C&M for conducting necessary negotiations with the Bidder to arrive at a mutually agreeable rate. Engineer's decision in regard to rates of such items shall be final and binding on the Bidder.

In case of conflict between this chapter and other Chapters of Technical Specifications, provisions given in this chapter shall govern.

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Table 1- Finishing Schedule

No	Location	Flooring & Skirting 150mm high	Wall Internal	Ceiling	Doors, Windows, Ventilators
1	Control room	Homogeneous PVC sheet 2 mm thick over 52 mm thick CC flooring with concrete hardener topping (item no. 11.4-DSR 2012).	Plastic emulsion Paint on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco/Jindal or equivalent extruded sections (minimum 3 mm thick) as per IS 733 & 1285 for doors, windows & ventilators (minimum thickness of powder coating 50 micron of approved colour). Glazing for doors, windows and ventilators will be hermetically sealed double glazing (DGU) with (6+12+6) i.e 06 mm clear toughened glass + 12 mm air gap + 6 mm toughened glass (Heat reflective colour glass).
2	Reception Lobby/ Maintenance Room	Polished Kota stone	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco/Jindal or equivalent extruded sections (minimum 3 mm thick) as per IS 733 & 1285 for doors, windows & ventilators (minimum thickness of powder coating 50 micron of approved colour). Glazing for doors, windows and ventilators will be hermetically sealed double glazing (DGU) with (6+12+6) i.e 06 mm clear toughened glass + 12 mm air gap + 6 mm toughened glass (Heat reflective colour glass).
3	Toilet	Anti skid Vitrified tiles with white cement.	DADO glazed tile 2.1m high for toilet, for pantry above working platform up to 750 mm.	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco/Jindal or equivalent extruded sections (minimum 3 mm thick) as per IS 733 & 1285 for doors, windows & ventilators (minimum thickness of powder coating 50 micron of approved colour). Glazing for doors, windows and ventilators will be hermetically sealed double glazing (DGU) with (6+12+6) i.e 06 mm clear toughened glass + 12 mm air gap + 6 mm toughened glass (Heat reflective colour glass).

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4	Stair	Polished Kota stone	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco/Jindal or equivalent extruded sections (minimum 3 mm thick) as per IS 733 & 1285 for doors, windows & ventilators (minimum thickness of powder coating 50 micron of approved colour). Glazing for doors, windows and ventilators will be hermetically sealed double glazing (DGU) with (6+12+6) i.e 06 mm clear toughened glass + 12 mm air gap + 6 mm toughened glass (Heat reflective colour glass).
5	Other areas not specified	Vitrified tile of approved size	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	
6	Switchgear Room	Epoxy flooring (2 mm) thick on top of 52 mm thick CC flooring with concrete hardener topping (item no. 11.4-DSR 2012).	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco/Jindal or equivalent extruded sections (minimum 3 mm thick) as per IS 733 & 1285 for doors, windows & ventilators (minimum thickness of powder coating 50 micron of approved colour). Glazing for doors, windows and ventilators will be hermetically sealed double glazing (DGU) with (6+12+6) i.e 06 mm clear toughened glass + 12 mm air gap + 6 mm toughened glass (Heat reflective colour glass).
7	The External finishing of Control room building will be of Stone grit/ Wash Marble chip of approved color and quality with color pigments using white / grey cement or combination of both.				
8	External finishing of the building on area other than the area of stone grit/ Wash Marble using Acrylic Smooth exterior paint (painting) shall be Asian apex ultima, Nerolac excel or equivalent The paint shade as approved by BRPL				



**Reliance Energy**

A Birla Group Company Enterprise

## Specification

### Outdoor Circuit Breaker

**(33 & 66 KV)**

Specification no. : SP-CBLU-01-R0

Prepared By		Reviewed By		Approved By		Revision	Date
Name	Sign.	Name	Sign.	Name	Sign.		
RH		HPB		DG		0	29-Jan-2005

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## General Specification

### 1.0.0 Codes & standards

The circuit breakers shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard, IEC standard and CBIP manuals as listed below-

#### National Standards

Indian Electricity Rules	
Indian electricity act	
CBIP manual	
IS-2516	Specification for circuit. Breaker.
IS-13118-1991	Specification for high voltage alternating current circuit-breaker
IS-335-1995	Insulating oil for Transformer & Switchgear.
IS-2090-1973	Bushing for alternating voltage above 1000 volts.
IS-731-1971	Insulator for Overhead lines.
IS -996-1979	Single phase small AC and Universal Electric Motors.
IS-7572-1974	Guide for testing single phase AC and Universal motors.
IS 4237-1967	General Requirement for switchgear for voltage not exceeding 1Kv.
IS-2147-1962	degree of protection provided by enclosure for low-voltage switchgear control gear.
IS-1554 Part-I 1988	PVC insulated cables up to & including 1100 volts.
IS-2208	HRC Cartridge fuses links up to 650 volts.
IS-375	Outdoor switchgear & control gear matching with latest IS/IEC requirement
IS-2544	Porcelain Post Insulator
IS-5621	Hollow insulators for use in electrical equipment



### International Standards

IEC-56	Specification for high voltage alternating current circuit-breaker
IEC- 62271 – 100	High Voltage alternating Current Circuit Breaker
IEC-60694	Common specification for high voltage switchgear and control gear standards
IEC-376	SF6 Gas

### 2.0.0 Circuit Breaker design features

2.1.0	Contacts	
2.1.1	Making & Breaking Contacts	Hermetically sealed, free from atmospheric effects , adjustable to allow for wear and shall have a minimum number of moveable parts and adjustments to accomplish these results.
2.1.2	Arcing Contacts	First to close and last to open
2.1.3	Main Contacts	First to open and last to close.
2.1.4	Material of tips of contact	Silver-plated and have tungsten alloy tipping.
2.2.0	Sulphur Hexa Fluoride Gas (SF6 Gas)	SF6 gas shall comply with IEC 376 , suitable in all respect for use in the switchgear under all the operating conditions.
2.3.0	Operating Mechanism	a) Suitable for high speed re-closing, anti-pumping and trip free (as per IEC definition) electrically or mechanically under every method of closing (except during closing for maintenance).
		b) The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping.
2.4.0	Indicators	Electrical indicator as well as mechanical indicator shall be provided for a) Open and close position indication of breaker. b) Spring Charged indication

		<p>c) Local / Remote indication</p> <p>These indications shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing closed.</p> <p>An operation counter shall also be provided with each breaker.</p>
		<p>SF6 gas density monitor shall be provided at 1.5 metre from ground level, tubing between gauge &amp; breaker shall be stainless steel.</p>
2.5.0	Closing Coil	<p>Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage.</p>
2.6.0	Tripping Coil	<p>a) Shunt trip shall operate correctly at all values of supply voltage between 70% and 110% of rated voltage.</p> <p>b) Trip coil shall be suitable for trip circuit supervision, the relay for monitoring which will be provided by the purchaser and mounted on control panel.</p>
2.7.0	Remote / Local Closing & Tripping	<p>a) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils.</p> <p>b) A conveniently located manual tripping lever or button shall also be provided for local tripping of the breaker and simultaneously opening the re-closing circuit. It shall be possible to trip the breaker in the event of auxiliary supply failure.</p>
2.8.0	Manual Spring Charging	<p>For spring charged mechanism a local manual closing device which can easily be operated by one man standing on the ground shall also be provided for maintenance purpose and</p>

		direction of motion of handle shall be clearly marked.
2.9.0	Spring Operated Mechanism	a) Complete with motor, opening spring and closing spring with limit switch for automatic charging and all other necessary accessories to make the mechanism a complete operating unit
		b) One close-open operation shall be possible after failure of power supply to motor
		c) Closing action of the circuit breaker shall compress the opening spring ready for tripping.
2.10.0	Motors	Motors shall be 'Universal type' capable of satisfactory operation for the application and duty as required by the driven equipment. Motor shall be rated for 240 Volts AC.
2.10.1	Duty Requirement	Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the system.
2.10.2	Supply Voltage Variation	± 10%
2.10.3	Frequency variation	± 5%
2.10.4	Combined voltage & frequency	± 10%
2.11.0	Interlocks	Necessary interlocks to prevent the closing or opening of the breaker under low SF6 pressure & devices for initiating alarm shall be provided
2.12.0	Control Cabinets	Operating mechanism and all accessories shall be enclosed in a control cabinet. A common marshalling box for the three poles of the breaker shall be provided.
2.12.1	Enclosure	Control cabinet enclosure shall be sheet steel enclosed, dust, weather and vermin proof with

		a degree of protection as mentioned in Annexure-B.
2.12.2	Mounting	Control cabinets shall be suitable for mounting on the breaker structure at sufficient height for easy operation.
2.12.3	Doors & Locks	Control, cabinets shall be provided with double hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
2.12.4	Control cables	Control cable entries shall be from bottom. Suitable removable, undrilled cable gland plate shall be provided on the cabinet for this purpose.
2.12.5	Heaters	Suitable heaters with auto control for ON/OFF at preset temp. shall be mounted in the cabinet to prevent condensation. ON/OFF switch and fuse shall also be provided. Heater shall be suitable for 240 V AC supply voltage
2.12.6	Terminals	<p>a) Terminal blocks shall be 650 V grade 10 Amps rating, complete with insulated barriers stud type terminals, washers, nuts and lock nuts and identification strips. Separate stud shall be provided for incoming and outgoing, wires. Marking of terminal strips shall correspond to wire number on diagrams.</p> <p>b) Terminal blocks shall be fully enclosed with easily removable covers and made of moulded non-inflammable plastic material. The terminal blocks shall have marking strips and all terminals shall be clearly marked with identification numbers or letters to facilitate connections to the external wiring</p>

		c) 20 percent spare terminal blocks shall be provided for purchasers use in addition to those already provided for interlocks
2.12.7	Illumination	A suitable switch to operate on opening of the door shall be provide to illuminate the interior of the control cabinet
2.12.8	Control Cubicle Wiring	All wiring shall be carried out with 650 Volt grade Single core stranded, flexible copper conductor wire with PVC insulation and shall be vermin and rodent proof. The size of control wire shall be 1.5 sqmm.
2.12.9	Lugs	Wire terminations shall be made with solderless crimping type of tinned copper lugs. All lugs shall be pre insulated type.
2.12.10	Sleeves	Insulated sleeves shall be provided at all the wire ends and shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks. The wire numbers on the wiring diagram shall be in accordance with IS: 375 or to the international Standard
2.12.11	Push Button	a) Close/Trip push buttons shall be momentary contact type. The color of the push button shall be subject to approval of the Purchaser. Each push Button shall be provided with integral inscription plates engraved with their function.
		b) All push buttons shall have two normally open and two normally open and two c normally closed contacts. The contact shall be able to make and carry 5 Amps at 220V/110V/50V DC and shall be capable of breaking 1 Amp. Inductive load
2.12.12	Switches	All control switches shall be of rotary switch type and toggle/piano switches shall not be

		accepted. All control switches shall be rated for 220V/110V/50V DC
2.12.13	MCB	220V/110V/50V DC, 16A DP MCB shall be used for control circuit and 240V AC, 10A SPN MCB shall be used for motor and heater circuit.
2.12.14	Earthing	a) All metal parts not intended for carrying current shall be made of stainless steel and connected to duplicate earthing system and suitable terminals shall be provided on each equipment or part of equipment in conformity with the I.E. Rules and relevant ISS.
		b) The earth continuity conductor shall have sufficient cross-sectional area so as afford a low resistance path for the full fault current corresponding to the Circuit breaker rating
		c) The size of earth continuity conductor shall be as large as possible to reduce the potential rise to minimum of the metal frame of the circuit breaker and in no case, more than 10 V.
		d) The size of earth conductor shall also be adequate, so as to restrict the temperature rise to the limit without causing any damage to the earth connection while short circuit current flows through it for the short time rating of the equipment
		e) No riveted joints in current conducting path shall be permitted. Only bolted joints with proper size of nuts & bolts with Plain/spring washer and also locking washer is permitted. The nuts & bolts shall made of stainless steel only.
2.13.0	Caution/Danger Plate	Caution name plate shall be provided at all points where terminals are likely to remain live

		and isolation is possibly only at remote end
2.14.0	Safety Interlocks	Suitable provision for safety electrical interlocks shall be made as per advise of the purchaser
2.15.0	Bushings	Porcelain used in bushing manufacture shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or di-electric quality and shall be thoroughly vitrified tough and impervious to moisture
2.15.1	Colour & Glazing of Bushing	Glazing of the porcelain shall be of uniform brown colour free from blisters, burns and similar other defects.
2.16.0	Galvanization	All iron parts shall be hot-dip galvanized
2.17.0	Nuts & Bolts	Nuts & Bolts shall be of stainless steel only
2.18.0	Joints	All joints shall be airtight. Surfaces of the joints shall be tarred up, porcelain parts by grinding and metal part of machining.
2.19.0	Creepage distance	The Creepage distance of the bushing shall in no case be less than 31mm/KV. Suitable for heavily polluted atmosphere
2.20.0	Duty Requirement of Circuit Breaker	a) The circuit breakers shall be totally re strike free under all duty conditions as per specification in Annexure-B
		b) The circuit breakers shall meet the above duty requirements in case of application on U/G cable circuits as well as on power transformer
		c) The circuit breaker shall be capable of Breaking the steady and transient magnetizing current corresponding to transformers Breaking line charging currents as per IS 2165 (Part-II Sec.2) with a temporary over voltage of 3.5 PU without the use of opening resistors.

		d) Breaking 25% of the rated fault current at twice rated voltage under phase oppositions conditions as per IS: 9135 1979
2.21.0	Transient recovery voltage	The rated transient recovery voltage for terminal fault and short line faults shall be as per IS: 2165.
2.22.0	Temperature rise	The temperature rise and the maximum temperature on any part of the equipment when in service at site under continuous full load condition and exposed continuously in the direct rays of the sun shall not exceed the permissible limits as per table-4 of IEC publication No. 56-2 and IS: 2516 when the standard specifies the limit of temperature rise. This shall not be exceeded when corrected for the difference between the ambient temperature at site and the ambient temperature specified in the relevant specification. The correction proposed shall be stated in the tender and shall be subjected to the approval of the purchaser
2.23.0	Painting	Polyurethane based paints shall be used. The color for the finishing paint shall be light gray as per shade No. 692 of IS-5.
2.24.0	Line side terminal connector	Al-alloy terminal connectors shall suitable for single/twin ACSR conductor as specified in Annexure-C.

### 3.0.0 Quality assurance

3.1.0	Vendor quality plan	To be submitted for purchaser approval
3.2.0	Inspection points	To be mutually identified & agreed in quality plan



#### 4.0.0 Testing & Inspection

4.1.0	Tests	Test shall be carried out in accordance with IS-13118 / IEC-56 / IEC-60694 / IEC-62271-100
4.1.1	Type Tests	a) Circuit breakers must be of type tested quality.
		b) In case, the product is never type tested earlier, seller has to conduct the type tests from Govt. recognized / Internationally accredited test Labs at their own cost, before commencement of supply.
		c) If the manufacturer's lab is accredited by govt. / authorised body then it shall be acceptable for type testing.
4.1.2	Routine test	Test shall be carried out in accordance with IS-13118 / IEC-56 / IEC-60694 / IEC-62271-100
4.1.3	Acceptance Test	Test shall be carried out in accordance with IS-13118 / IEC-56 / IEC-60694 / IEC-62271-100
4.2.0	Tests on fitting and Accessories	As per Manufacturer's Standards
4.3.0	Inspection and Testing	a) The Buyer reserves the right to witness all tests specified on completed product.
		b) The Buyer reserves the right to inspect the product at the Seller's works at any time prior to dispatch, to verify compliance with the specifications.
		c) In-process and final inspection call intimation shall be given in advance to purchaser.

### 5.0.0 Drawings, Data & manuals

5.1.0	To be submitted along with bid	The seller has to submit :
		a-1: Complete assembly drawing of the outdoor type circuit breaker showing plan, elevation and typical sectional view giving complete dimensions.
		a-2: Assembly drawings and weight of main component parts
		a-3: Drawings showing the loads for foundations
		a-4: Schematic control and wiring diagram in accordance with National / International practice
		a-5: Structural drawing and the breaker mounting arrangement
		a-6: Rating Plate diagram
		a-7: Drawings of terminal connectors
		b) Detailed reference list of customers already using the offered product during the last 5 years with similar design and rating.
		c) Completely filled GTP
		d) Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.
		e) Details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification.
		f) Type test reports shall be submitted for the type, size & rating of product / equipment offered along with bid. They shall be considered valid for 5 years from date of test performed on product /equipment.

		g) Complete product catalogue and Manual along with the bid.
		h) Recommended spare parts and consumable items for five years of operation with prices and spare parts catalogue with price list for future requirements
5.2.0	After award of contract, seller has to submit mentioned drawings for buyer's Approval (A) / Reference (R)	a) Programme for production and testing (A)
		b) Guaranteed Technical Particulars (A)
		c) Calculations to substantiate choice of electrical, structural, mechanical component size / ratings (A)
		e-1: General arrangement drawing of the circuit breaker (A).
		e-2: Schematic wiring diagram of the circuit breaker external wiring termination along with terminal and wiring numbers for the various equipment controlled from the control panel etc (A)
		e-3: Foundation drawings of circuit breaker with size & nos of foundation bolts (A)
		e-4: Structural erection drawings (A)
		e-5: Terminal connector drawings. (A)
		e-6: Detailed loading drawing to enable the buyer to design and construct foundations (as applicable) (R)
		e-7: General arrangement drawing of control cabinet (A)
		f) detailed installation and commissioning instructions (R)
		g) quality plan

5.3.0	Submittals required prior to dispatch	a) Inspection and test reports, carried out in manufacturer's works (R)
		b) Test certificates of all bought out items
		c) Operation and maintenance Instruction as well as trouble shooting charts/ manuals
5.4.0	Drawing and document sizes	Standard size paper A0, A1, A2, A3, A4
5.5.0	No of drgs. / Documents required at different stages	As per Annexure- A

### 6.0.0 Packing, Shipping, Handling & Storage

6.1.1	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration
6.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
6.1.3	Packing Identification Label	In each packing case, following details are required :
		a) Individual serial number
		b) Purchaser's name
		c) PO number (along with SAP item code, if any) & date
		d) Equipment Tag no. (if any)
		e) Destination
		f) Manufacturer / Supplier's name
		g) Address of Manufacturer / Supplier / it's agent
		h) Description and Quantity
		i) Country of origin
		j) Month & year of Manufacturing
		k) Case measurements
		l) Gross and net weights in kilograms
		m) All necessary slinging and stacking instructions
6.2.0	Shipping	a) Bidder shall furnish the confirmation that the proposed packages can be delivered safely upto the site.

		b) The seller shall be responsible for all transit damage due to improper packing.
6.3.0	Handling & Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.

### 7.0.0 Progress reporting

7.1.0	Outline Document	To be submitted for purchaser approval for outline of production, inspection, testing, packing, dispatch, documentation programme
7.2.0	Detailed Progress report	To be submitted to Purchaser once a month containing <ul style="list-style-type: none"> <li>a) Progress on material procurement</li> <li>b) Progress on fabrication (As applicable)</li> <li>c) Progress on assembly (As applicable)</li> <li>d) Progress on internal stage inspection</li> <li>e) Reason for any delay in total programme</li> <li>f) Details of test failures if any in manufacturing stages</li> <li>g) Progress on final box up</li> <li>h) Constraints / forward path</li> </ul>

### 8.0.0 Deviations

8.0.0	Deviation from the Specification	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed by the Buyer that the Seller complies fully with this specification.
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## Annexure - A Scope of supply

### 1.0 The scope of supply shall include following

- 1.1 Design, manufacture, testing at manufacturer works before dispatch, packing, delivery of Circuit Breaker as per BOQ and submission of all documents.
- 1.2 Supply of SF6 Gas cylinder for first filling.
- 1.3 Gas filling equipment with valves and tubing
- 1.4 Terminal connector
- 1.5 Hot-dip galvanized supporting structure along with foundation bolts.
- 1.6 Supervision of testing & commissioning of Circuit Breaker at site
- 1.7 BOQ as following -

Sr No	Purchaser Equipment Tag No / SAP code	Equipment Description	Location / Substation name	Unit	Quantity
1			e.g. Santacruz	No	e.g. 1
2			e.g. Alaknanda	No	e.g. 1
3					
4					
5					
6					
7					

### 2.0 Submission of documents

Submission of drawings, calculations, catalogues, manuals, test reports shall be as follows-

	Along with offer	For Approval after award of contract	Final after approval	Remarks
Drawings	3 copies (Typical drgs)	4 copies	6 copies + 1 soft copy in CD	See Clause 5.0 for various drawings required
Calculations	3 copies (Typical)	4 copies	6 copies + 1 soft copy in CD	See Clause 5.0 for details

Catalogues	1 copy		6 copies + 1 soft copy in CD	
Instruction manual for the circuit breaker	1 copy		6 copies + 1 soft copy in CD	
Test Report	2 copies		6 copies + 1 soft copy in CD	Type test and sample routine test reports

### Delivery schedule

- 2.1 Delivery period start date - from date of purchase order
- 2.2 Delivery period end date - as agreed with supplier
- 2.3 Material dispatch clearance - after inspection by purchaser and  
written dispatch clearances for  
purchaser

**Annexure – B Service Conditions**

1.0.0	Mumbai Atmospheric conditions	
a)	Average grade atmosphere :	Heavily polluted , salt Laden, dusty, humid with possibility of condensation
b)	Maximum altitude above sea level	1000 M
c)	Ambient Air temperature	Highest 45 deg C, Average 35 deg C
d)	Minimum ambient air temperature	20 deg C
e)	Relative Humidity	100 % Max
f)	Thermal Resistivity of Soil	150 Deg.C cm/W
g)	Seismic Zone	3
h)	Rainfall	3000 mm concentrated in four months

2.0.0	Delhi Atmospheric conditions	
a)	Average grade atmosphere :	Heavily polluted, dry
b)	Maximum altitude above sea level	1000 M
c)	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
d)	Minimum ambient air temperature	0 Deg C
e)	Relative Humidity	100 % Max
f)	Thermal Resistivity of Soil	150 Deg.C cm/W
g)	Seismic Zone	4
h)	Rainfall	750 mm concentrated in four months



**Annexure - C Guaranteed Technical Particulars (33kV Circuit Breaker)**

Sr. No.	Description	Data By Purchaser	Data By Supplier
1.0	Name of manufacturer		
2.0	Manufacturer's type and designation		
3.0	Governing standard	As per Clause 1.0.0 Of the specification	
4.0	Type of circuit breaker	Vacuum	
5.0	Installation	Outdoor	
6.0	No. of phase & no. of pole	3 (Three), 3 (Three)	
7.0	Rated voltage (kV)	33kV	
8.0	Highest system voltage (kV)	36kV	
9.0	System Neutral	Solidly earthed	
10.0	Rated insulation level	170kVp	
11.0	Frequency (Hz)	50Hz	
12.0	Class		
13.0	Normal current rating (amps)		
13.1	Under standard conditions	1250A	
13.2	Under site conditions overload rating a) 1 Hour b) 3 Hour		
13.3	Derating factor, if any, for site condition		
13.4	Temperature rise at 150% rating for 3 Hours		
14.0	Short time current rating (kA) (a) For 1 Second (b) For 3 Second	25kA	

Sr. No.	Description	Data By Purchaser	Data By Supplier
15.0	Maximum temperature rise over highest ambient ( refer annexure-B ) due to rated current in main contacts, measured after breaking test.	40 deg C	
16.0	Rated short circuit breaking current		
16.1	Rated short circuit current (Ac component)		
16.2	Percentage DC component at KV		
16.3	Asymmetrical breaking Current (including DC Component)		
16.4	Making capacity (KA peak) – at KV		
17.0	Rated operating sequence	O-0.3Sec.-CO-3Min.-CO	
18.0	Total break time (Milli-seconds) :		
18.1	For interruption of 10% of the rated capacity	60ms (max)	
18.2	For interruption of 30% of the rated capacity	60ms (max)	
18.3	For interruption of 60% of the rated capacity	60ms (max)	
18.4	For interruption of the full rated capacity	60ms (max)	
19.0	Arcing time (Milli-seconds)		
20.0	Opening time (Milli-seconds)		

Sr. No.	Description	Data By Purchaser	Data By Supplier
21.0	Break time (Milli-seconds)		
22.0	Closing time (Milli-seconds)	60ms (max)	
23.0	Minimum re-closing time at rated interrupted capacity from the instant of the trip coil energisation (Milli-seconds)		
24.0	Minimum dead time for		
24.1	3 phase re-closing (Milli-seconds)		
24.2	Limit of adjustment of dead time for 3- phase re-closing.		
25.0	Data on re-striking voltage for 100%, 50% or 30% rated capacity	100% 50% 30%	
25.1	Phase factor		
25.2	Amplitude factor		
25.3	Natural frequency (Hz)		
25.4	Rate of rise of re-striking voltage (V/micro sec.)		
26.0	Rated out-of phase breaking current		
27.0	Rated line charging breaking current		
28.0	Maximum line charging current breaking capacity and corresponding over-voltage recorded in test: a) On supply side b) On line side		

Sr. No.	Description	Data By Purchaser	Data By Supplier
29.0	Maximum cable charging current : breaking capacity and corresponding over-voltage recorded in test: a) On supply side. b) On line side		
30.0	Rated single capacitor bank :		
30.1	Capacity in rush current handling, capability		
30.2	Capacitive breaking current Capability.		
31.0	Rated small inductive breaking current and the corresponding over voltage		
32.0	First pole to clear factor	1.5	
33.0	Rated transient recovery voltage for terminal faults		
34.0	Rated characters for short line faults is rate of rise.		
30.0	Rated short circuit breaking current		
35.0	Dry 1-minute power frequency test withstand voltage, for complete circuit breaker		
35.1	Between line terminal and grounded parts (KV rms)	80kV (rms)	

Sr. No.	Description	Data By Purchaser	Data By Supplier
35.2	Between terminals with breaker contact open (KV rms)	80kV (rms)	
36.0	Wet 1-minute power frequency test withstand voltage :		
36.1	Between line terminal and grounded parts (KV rms)	75kV (rms)	
36.2	Between terminals with breakers contacts open (KV rms)	75kV (rms)	
36.3	Between poles		
37.0	1.2/50 microsecond wave impulse with stand test voltage for complete circuit breaker:		
37.1	Between line terminal and ground (KV peak)	200kVp	
37.2	Between terminal with circuit breaker contacts open.	200kVp	
37.3	Between Poles		
38.0	Minimum Clearance in air.		
38.1	Between phases (mm).	320mm (min)	
38.2	Live parts and earth (mm).	320mm (min)	
38.3	Live parts to ground level (mm).	3700mm (min)	

Sr. No.	Description	Data By Purchaser	Data By Supplier
39.0	Number of operation possible without maintenance.		
39.1	At full rated interrupting capacity		
35.2	At 150% of rated current.		
39.3	At 100% of rated current		
39.4	At 50% of rated current.		
40.0	Supporting Insulator		
40.1	Make and type.		
40.2	Insulation class	A	
40.3	Weight.		
40.4	Transport dimensions.		
40.5	Visible corona discharge voltage		
40.6	Dry-1 minute power frequency flashover voltage.	70kV rms	
40.7	Wet-1-minute power frequency lashover voltage.	70kV rms	
40.8	1.2/50 microsecond impulse flashover voltage.	170kVp	

Sr. No.	Description	Data By Purchaser	Data By Supplier
40.9	Creepage distance to ground (mm) a) Total b) Protected	31mm/kV	
41.0	No. of breaks per pole	1 (one)	
42.0	Total length or breaks per phase (mm)		
43.0	Type of main contacts		
44.0	Material of main contacts	Silver plated copper	
45.0	Whether main contacts silver plated (Yes/No.) Thickness of silver coating on main contacts (mm).	15 +/- 5 microns (min)	
46.0	Contact pressure on arcing contacts (kg/m <sup>2</sup> ).		
47.0	Type of arcing contacts		
48.0	Contact pressure on main contact (kg/m <sup>2</sup> ).		
49.0	Type of auxiliary switches.		
50.0	Whether all contacts silver plated (Yes/No)		
51.0	No. of auxiliary switch contacts operating with all three poles of breaker		
51.1	Which are closed when breaker is closed.		

Sr. No.	Description	Data By Purchaser	Data By Supplier
51.2	Which are open when breaker is closed		
51.3	Those adjustable with respect to the position of main contacts		
52.0	No. of spare auxiliary switch contacts operation with all three poles of breaker:		
52.1	Which are closed when breaker is closed	6 (six)	
52.2	Which are open when breaker is closed	6 (six)	
52.3	Those adjustable with respect to the position of main contacts		
53.0	Total number of terminal block		
54.0	Number of spare terminal Block:	20%	
55.0	Mounting flange details: (a)Opening. (b)Closing.		
56.0	Tripping and closing circuit voltage (V).	50V/110V/220V DC	
57.0	Power required for trip coil		
58.0	Power required for closing coil.		
59.0	Rated voltage for spring charging motor	240V AC	
60.0	Rated voltage of space heater and socket	240V AC	



Sr. No.	Description	Data By Purchaser	Data By Supplier
61.0	Contingencies for which alarm provided		
62.0	Design data for supporting structure.		
63.0	Weight of supporting steel structure for breaker.		
64.0	Descriptive leaflets enclosed (Yes/No)		
65.0	Operating Mechanism		
65.1	Type of operating mechanism offered		
65.2	Manufacturer's type designation		
65.3	Material of control cabinet enclosure		
65.4	Thickness of sheet metal enclosure	3.0mm for bottom and 2.5mm elsewhere.	
65.5	Painting & colour shade	Polyurethane paint, 692 of IS-5	
65.6	Enclosure protection	IP 55	
65.7	Pad locking facility provided (Yes/No)		
65.8	Wring a) Control wire size b) Insulation c) Colour	1.5 Sqmm 650V Grey for control, Black for AC and Green for earth	

Sr. No.	Description	Data By Purchaser	Data By Supplier
65.9	Normal power consumption at rated voltage (Watt)		
65.10	Normal power of spring charging motor		
65.11	Number of close/open operation possible after failure of AC supply to motor		
65.12	Time required to charge the closing spring		
65.13	Whether indication of spring charged condition provided in central control cabinet (Yes/No)	Yes	
65.14	Dimension of the control cabinets.		
65.15	Weight of control cabinet		
66.0	Details of safety interlock provided		
67.0	Whether supporting structure for circuit breaker provided (Yes/No)	Yes	
67.1	Thickness of galvanizing (mm)		
67.2	Size of foundation bolts		
68.0	Material of nuts & bolts	Stainless steel	
69.0	Weight of 3-phase breaker complete with operating mechanism, insulating support frame work, etc.		

<b>Sr. No.</b>	<b>Description</b>	<b>Data By Purchaser</b>	<b>Data By Supplier</b>
70.0	Impact loading for foundation design to include load plus impact value on opening at maximum interrupting ratings in terms of equivalent of static load.		
71.0	Weight of heaviest package		


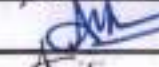
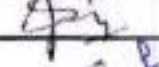
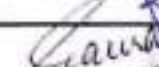
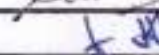

# BSES

## Technical Specification

Of

66/33 kV Control and Relay Panel

Specification no – BSES-TS-86-CRP-R0

Rev:	0	
Date:	03 Jun 2022	
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## 1.0 SCOPE

- This specification covers design, manufacture, testing at manufacturer's works, packing and delivery of control and relay panel (CRP) for 66kV and 33kV substations.
- The control and relay panel shall be complete with all components and accessories, which are necessary or usual for their efficient performance and trouble free operation under the various operating and atmospheric conditions. Such parts that may have not been specifically included, but otherwise form part of the CRP as per standard trade and/or professional practice and/or are necessary for proper operation of control and relay panel, will be deemed to be included in this specification.
- Scope also Includes-Licensed programming software and communication cord for offered numerical relays, one set of special tools and tackles (if any) required for maintenance of CRP and its components, Spares as per Annexure C, All relevant drawings, data and instruction manuals.

## 2.0 CODES AND STANDARDS

Control and Relay panel should be designed and manufactured in accordance with the following standards.

2.1	IS-1248, Part 1- 1993	Direct acting indicating analogue electrical measuring instruments and their accessories.
2.2	IS-3231, Part 1- 1986 Part 2 &3 -1987	Electrical relays for power system protection
2.3	IS-9000 Part 1 -1988	Basic environmental testing procedures for electronics & electrical items
2.4	IS-13703 1993	Low voltage fuses for Voltages not exceeding 1000V AC or 1500 V DC
2.5	IS-13947 Part 1 - 1993	Low voltage switchgear & control gear
2.6	IEC-60255 - 1989	Specification for electrical relays
2.7	IEC 60688 1997	Electrical measuring transducers

## 3.0 PANEL CONSTRUCTION

3.1	Panel Type	Simplex panels with Width - 1000mm/1250 mm and Depth – 800 to 1000mm. Equipment shall be mounted on the front of the panel and doors for wiring access shall be at the back of panels.
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**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

3.2	Enclosure type	Completely metal enclosed and dust, moisture and vermin proof. Degree of protection not less than IP4X in accordance with IS 13947
3.3	Enclosure material	Pre-galvanized, cold-rolled sheet steel of thickness not less than 2.0 mm. Stiffeners shall be provided wherever necessary.
3.4	Doors	Double leaf doors shall be provided at the rear. Doors shall have handles with built-in locking facility. Locks of the door shall be lever type.
3.5	Gland Plate	At least two separate gland plates of removable type with gasket shall be provided for each panel. They shall be of sheet steel of thickness not less than 3.0 mm.
3.6	Cable Entry	Shall be from the bottom
3.7	Cable clamping	Cable glands shall not be used to support control cables. Vendor must provide clamping arrangement of control cable.
3.8	Gaskets	All doors, removable covers and panels shall be Gasketed all around with neoprene gaskets.
3.9	Ventilating louvers	Ventilating louvers, if required, shall have screens and filters. The screens shall be made of either brass or GI wires mesh.
3.10	Foundation	The panels shall be fixed on the embedded foundation channels with intervening layers anti vibration strips made of shock absorbing materials.
3.11	Base Frame	Base frames shall be supplied along with panels. 100mm channel painted black.
3.12	Mounting	Equipment on front of panel shall be flush mounted. No equipment shall be mounted on the doors.
3.13	Working level	The center lines of switches, push buttons and indicating lamps shall not be less than 750mm and higher than 1600mm from panel base. Height of relays, meters and recorders shall not be less than 450 mm from the bottom of the panel.
3.14	Appearance	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.
3.15	Make	To be provided by Vendor

**4.0 WIRING**

4.1	Internal wiring	1100V grade, FRLS type, single core, stranded copper conductor wires with PVC insulation.
4.2	Size	2.5 sqmm for CT circuits, 2.5 sqmm for PT and control circuits.
4.3	Color Code	
4.3.1	CT & PT	R Ph – Red Y Ph – Yellow B Ph – Blue Neutral – Black
4.3.2	Others	DC– grey, AC-black, Earth – green
4.4	Ferrules	Ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire. Wires directly connected to trip circuit shall be distinguished by the addition of red colored unlettered ferrule.
4.5	Termination	Fork type, pin type and ring type (as applicable) tinned copper lugs to be used. Only ring type lugs should be used in CT circuits. Insulated sleeves shall be provided at all the wire terminations.
4.6	Wiring Enclosure	Plastic channels to be used as enclosures. PVC sleeves to be used for interpanel wiring.
4.7	Spare Contacts	Spare contacts of relays and contactors etc. should be wired up to the terminal block.
4.8	Inter-panel wiring	When panels are arranged to be located adjacent to each other inter panel wiring of common bus wires between the panels should be supplied with one end terminated and the other end bunched and coiled. Inter panel wiring shall be clearly indicated in the wiring tables.
4.9	Auxiliary supply	Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided on the same set of terminals in all the panels with proper segregation.



**5.0 TERMINAL BLOCKS**

5.1	Rating and Type	1100 V grade, molded piece, stud type screw driver operated terminals complete with insulated barriers, washers, nuts and lock nuts.
5.2	Suitability	Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of cable on each side- a. All circuits including current / voltage transformer circuits: 6mm <sup>2</sup> flexible copper. b. AC / DC power supply circuits: one no of 10 mm <sup>2</sup> Al./ 6 mm <sup>2</sup> flexible Cu.
5.3	Marking and covers	White fibre markings strip with clear plastic, slip-on / clip-on terminal covers to be provided.
5.4	Disconnecting Facility	To be provided in CT and PT terminals
5.5	Shorting & Earthing Facility	To be provided in CT Terminals
5.6	Spare Terminals	20% in each TB row
5.7	Segregation	TBs shall be segregated by application i.e separate terminal blocks shall be provided for each application as follows (a) CT (b) PT (c) Circuit Breaker (d) Bus Isolator (e) Line Isolator-1 (f) Line Isolator-2 (g) Earth Switch-1 (h) Earth Switch-2 (i) Interpanel Bus wiring etc.
5.8	Vertical clearance with gland plate	Minimum 250mm
5.9	Clearance between two rows of TBs	Minimum 150mm
5.10	Test Terminal Blocks	Screw driver operated stud type for metering circuits.
5.11	Arrangement	Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal block runs in parallel and close proximity to each side of the wiring duct. The side of the terminal block opposite the wiring duct shall be reserved for the external cable connection.

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5.12	Categorization	For ease of external connections, terminal blocks shall be categorized based on their usage i.e all terminals for wiring of particular equipment like circuit breaker should form one terminal block.
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**6.0 PAINT**

6.1	Paint Type	Powder coated. Pure Polyester base grade-A, structure finish.
6.2	Paint Shade	RAL7032 'Siemens Grey'
6.3	Paint Thickness	Minimum 50 microns

**7.0 MIMIC DIAGRAM**

7.1	System Representation	Colored mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels
7.2	Material	Mimic diagram shall be made preferably of painted aluminum or plastic (approved material), which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2-3 mm thick. The width of the mimic bus shall be 12mm for bus bars and 10 mm for other connections.
7.3	Mimic Indications	LED indications are to be used for breaker and isolator position and semaphore indicators shall be used for earth switch position.

**8.0 NAMEPLATES AND MARKINGS**

8.1	Nameplates	To be provided as per the following description
8.1.1	Equipment Nameplates	a. All equipment mounted on front side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. b. All front mounted equipment shall be also provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.
8.1.2	Feeder Nameplates	(a) Large and bold name plate carrying the feeder identification numbers shall be provided for circuit / feeder designation on the top of each panel on front as well as rear side. (b) Rear bottom of each panel shall have a nameplate

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		clearly indicating the following: (i) Customer Name (ii) BSES, PO No. & date (iii) Drawing Reference No (iv) Year of Manufacture (v) Control Voltage (vi) Customer care No
8.1.3	Material	Non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering. Stickers are not allowed.
8.1.4	Fixing	All nameplates/rating plates shall be riveted to the panels at all four corners. Bolting/screwing is not acceptable.
8.2	Markings	Each switch shall bear clear inscription identifying its function. Similar inscription shall also be provided on each device whose function is not otherwise identified. If any switch or device does not bear this inscription separate nameplate giving its function shall be provided for it. Switch shall also have clear inscription for each position indicating e.g. Trip-Neutral close, ON-OFF etc.

**9.0 EARTHING**

9.1	Panel Earthing	All panels shall be equipped with an earth bus securely fixed.
9.2	Location of earthing earthing bus	Earthing bus shall be at rear side of CRP(Door Side)
9.3	Material	The material and the sizes of the bus bar shall be 25 x 6 mm copper flat unless specified otherwise.
9.4	Earth Bus joints	All bolted joints in the bus should be effected by connection of two bolts.
9.5	Hinged Doors	Earthed through flexible copper braid.
9.6	Instrument and Relay Earthing	All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 mm <sup>2</sup> . The color code of earthing wires shall be green.
9.7	CT and PT circuit earthing	PT and CT secondary neutral shall be earthed at one place only at the terminal blocks through links.

**10.0 INSTRUMENTS**

10.1	Mounting	Flush mounted
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10.2	Voltmeter	Digital type with programmable ratio
10.2.1	Size	96x96 mm
10.2.2	Panels where to be provided	Incomer and Buscoupler
10.2.3	Voltmeter selector switch	Required
10.2.4	Accuracy Class	1.0
10.2.5	Auxiliary Supply	48 – 240VDC and AC i.e universal type.
10.2.6	Make	To be Provided by Vendor
10.2.7	Type/Model	To be Provided by Vendor
10.2.8	VA Burden	To be Provided by Vendor
10.3	Multifunction Meter	Digital type with programmable ratio
10.3.1	Model	Rish Delta Energy,
10.3.2	Make	Rishabh
10.3.3	SCADA Interfacing	RS485 rear port suitable for integration on Modbus Protocol
10.3.4	Size	96x96 mm
10.3.5	Panels where to be provided	All panels
10.3.6	Accuracy Class	1.0
10.3.7	Auxiliary Supply	48 – 240VDC and AC i.e universal type.
10.4	Energy meter provision	Energy meter is not in supplier's scope. Only space and CT/PT wiring is to be provided in all panels except bus coupler and bus PT. Space shall be 350 mm (H)x200 mm (W)

**11.0 RELAYS**

11.1	General features of Protection Relays	
11.1.1	Technology and Functionality	Numerical, microprocessor based with provision for multifunction protection, control, metering and monitoring
11.1.2	Mounting	Flush Mounting, IP5X
11.1.3	Architecture	Hardware and software architecture shall be modular and dis-connectable to adapt the protection and control unit to the required level of complexity as per the application.
11.1.4	Programming and configuration	Relay shall utilize a user friendly setting and operating multi-lingual software in windows environment with menus and

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		icons for fast access to the data required. Programming software and communication cord for offered relays should be included in scope of supply.
11.1.5	SCADA Interface port	(a) RS485 for IEC 103 communication. (b) LC Type Dual fibre optic port for interfacing with SCADA on IEC 61850 with PRP compatibility. Through this port relays shall be connected to Ethernet switches.
11.1.6	Communication Protocol	IEC103(Data Type 9) and Dual fibre optic port for interfacing with SCADA on IEC 61850 with PRP compatibility. Through these ports relays shall be connected to switches. Communication protocol shall be selectable at site.
11.1.7	Processing Indications	SCADA functions in monitoring direction shall be executed on SPI (Single Point Input) and DPI (Double Point Input). DPI shall only be used in case of Isolator and Circuit breaker "close" and "open" indication.
11.1.8	Command Processing	Functionality of command processing offered for SCADA interface shall include the processing of single and double commands i.e SCO (Single Command Output) and DCO (Double object command Output). DCO shall only be used in case of Isolator and Circuit Breaker close" and "open" command.
11.1.9	PC Interface port	Front port (preferably serial) for configuration/data download using PC.
11.1.10	GOOSE messaging	Relays shall communicate all status signals, commands and events on GOOSE messaging. Interlocks if any shall also be on GOOSE Messaging and wiring for that shall be in vendor's scope.
11.1.11	User Interface	An alphanumeric key pad and graphical LCD display with backlight indicating measurement values and operating messages. It should be possible to access and change all settings and parameters without the use of PC.
11.1.12	Relay Characteristics	Relay shall integrate all necessary protections for different applications in accordance with IS and IEC. Relay shall provide wide setting ranges and choice of all IEC, IEEE and other tripping curves through a minimum of two setting groups.
11.1.13	Event and Fault records	(c) Relay shall have the facility of recording of various parameters during event/fault with option to set the duration of record through settable pre fault and post fault time. (d) Relay shall store records for last 100 events (minimum) (e) Relay shall store records for last 10 faults (minimum). (f) It should be possible to download records locally to PC and to remote SCADA.
11.1.14	Measurement	Relays shall communicate all measured and monitored parameters like current, voltage, active power, reactive power, apparent power, power factor, phase angle, event

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		record, fault record, DIs , DOs etc to SCADA SCADA Integration Relays shall communicate all measured and monitored parameters like current, voltage, power, event record, fault record, DIs , DOs etc to SCADA
11.1.15	Self-diagnosis	Relay shall be able to detect internal failures and same shall be transmitted to SCADA as a soft signal. A watchdog relay with changeover contact shall provide information about the failure for annunciation.
11.1.16	Time synchronization	All relays shall be capable of being synchronized with the system clock through SCADA, PC and GPS.
11.1.17	Operation Indicators	(a) LEDs with push button for resetting. (b) Resetting of LEDs shall be possible from SCADA
11.1.18	Test Facility	Inbuilt
11.1.19	Coating	Conformal Type
11.2	Protection Relay Requirement for Line CRP (66kV/33kV)	
11.2.1	Relay 1	Combined Line differential (Dual channel, ST Port Compatible for Single Mode Fibre having wavelength 1310 nm) and distance protection
		Power Swing Blocking
		Software based CT ratio correction
		Dedicated port for communication with remote end relay through optical fibre. This port should be in addition to PC interface and SCADA interface ports.
11.2.2	Relay 2	Bay Control unit having MIMIC with 3-phase Directional Overcurrent and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
		Under and Over voltage
		Sync check function
		Trip Circuit Supervision- 1&2
		Reverse Blocking Function
		Under Frequency, Over Frequency and Rate of change of frequency
		PT supervision
Circuit Breaker failure protection (CBFP)		
11.2.3	User Configurable DIs and DOs	(a) Relay-1 should have DIs and DOs as per scheme requirement. Same shall be finalized during detailed engineering. 2 DIs and 2 DO shall be spare for future use. (b) Relay-2 should have minimum of 32 DIs and 16 DOs Exclusively for SCADA interfacing. DIs and DOs for tripping and interlocking shall be additional as per scheme

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		requirement. If DIs and DOs for tripping and interlocking are integrated with DIs and DOs meant for SCADA (may be done to optimize DI/DO configuration), atleast 4 DIs and 4 DOs should be available as spare in each panel for future use.
11.2.4	Note	Combining functions of Relay-1 and Relay-2 in single relay is not acceptable.
11.2.5	SLD	Refer annexure D1 and D5 for SLD of 66kV and 33kV line bays respectively
11.3	Protection Relay Requirement for Transformer CRP (66kV/33kV)	
11.3.1	Relay-1	Biased Differential Protection
		High Impedance REF protection
		Software based ratio and vector correction feature (without ICT)
		H2 and H5 harmonic restraint
11.3.2	Relay-2	Bay Control unit having MIMIC with 3-phase Directional Overcurrent and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
		Under and Over voltage
		Sync check function
		Trip Circuit Supervision- 1&2
		Reverse Blocking Function
		Under Frequency, Over Frequency and Rate of change of frequency
		PT supervision
11.3.3	User Configurable DIs and DOs	(a) Relay-1 should have DIs and DOs as per scheme requirement. Same shall be finalized during detailed engineering. 2 DIs and 2 DO shall be spare for future use. (b) Relay-2 should have minimum of 32 DIs and 16 DOs Exclusively for SCADA interfacing. DIs and DOs for tripping and interlocking shall be additional as per scheme requirement. If DIs and DOs for tripping and interlocking are integrated with DIs and DOs meant for SCADA (may be done to optimize DI/DO configuration), atleast 4 DIs and 4 DOs should be available as spare in each panel for future use.
11.3.4	Note	Combining the functions of Relay-1 and Relay-2 in a single relay is not acceptable.
11.3.5	SLD	Refer annexure D2 and D6 for SLD of 66kV and 33kV transformer bays respectively

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11.4	Protection Relay Requirement for Bus Coupler CRP (66kV/33kV)	
11.4.1	Relay-1	Bay Control unit having MIMIC with 3-phase Directional Overcurrent and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
		Under and Over voltage
		Sync check function
		Trip Circuit Supervision- 1&2
		Reverse Blocking Function
		Under Frequency, Over Frequency and Rate of change of frequency
		PT supervision for Bus PT-1 and Bus PT-2
		Circuit Breaker failure protection (CBFP)
11.4.2	Relay-2	PT supervision (fuse failure monitoring) for Bus PT-2 if not provided as part of relay-1
		Reverse Blocking Function
11.4.3	User Configurable DIs and DOs	(a) Relay-1 should have DIs and DOs as per scheme requirement. Same shall be finalized during detailed engineering. 2 DIs and 2 DO shall be spare for future use. (b) Relay-2 should have minimum of 32 DIs and 16 DOs Exclusively for SCADA interfacing. DIs and DOs for tripping and interlocking shall be additional as per scheme requirement. If DIs and DOs for tripping and interlocking are integrated with DIs and DOs meant for SCADA (may be done to optimize DI/DO configuration), atleast 4 DIs and 4 DOs should be available as spare in each panel for future use.
11.4.4	SLD	Refer annexure D3 and D7 for SLD of 66kV and 33kV bus coupler bays respectively
11.5	Protection Relay Requirement for Capacitor CRP (66kV/33kV)	
11.5.1	Relay-1	Neutral unbalance relay (current based)
		Timer for ON time delay (600 seconds minimum)
11.5.2	Relay-2	Bay Control unit having MIMIC with 3-phase Directional Overcurrent and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
		Overvoltage and Under voltage protection
		Sync check function
		Trip Circuit Supervision- 1&2



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		Reverse Blocking Function
		Under Frequency, Over Frequency and Rate of change of frequency
		PT supervision
		Circuit Breaker failure protection (CBFP)
11.5.3	User Configurable DIs and DOs	(a) Relay-1 should have DIs and DOs as per scheme requirement. Same shall be finalized during detailed engineering. 2 DIs and 2 DO shall be spare for future use. (b) Relay-2 should have minimum of 32 DIs and 16 DOs Exclusively for SCADA interfacing. DIs and DOs for tripping and interlocking shall be additional as per scheme requirement. If DIs and DOs for tripping and interlocking are integrated with DIs and DOs meant for SCADA (may be done to optimize DI/DO configuration), atleast 4 DIs and 4 DOs should be available as spare in each panel for future use.
11.5.4	Note	Combining the functions of Relay-1 and Relay-2 in a single relay is not acceptable
11.5.5	SLD	Refer annexure D4 and D8 for SLD of 66kV and 33kV capacitor bays respectively
11.6	SCADA Interfacing of Protection Relays	
11.6.1	Configuration and wiring of DIs of protection relays for routing status signals to SCADA	DI-1 – CB Open DI-2 – CB Close DI-3 – Earth switch 1 close DI-4 – Earth switch 2 close DI-5 – Line Isolator Open (For Bus Coupler Panel - Earth switch 3 close) DI-6 – Line Isolator Close (For Bus coupler panel - Earth switch 4 close) DI-7 – Bus 1 Isolator Open DI-8 – Bus 1 Isolator Close DI-9 – Bus 2 Isolator Open DI-10 – Bus 2 Isolator Close DI-11 – TC Healthy DI-12 – CB Spring Charged DI-13 – SF6 Low/ SF6 Lockout DI-14 – Local/Remote switch in Remote DI-15 – CB Autotrip DI-16 – Protection/Trip relay faulty DI-17 – DC fail/DC MCB trip from adjacent panel (DC -1/2 fail for bus coupler panel) DI-18 – PT MCB trip (wherever relevant) Sequence of DIs should be strictly as mentioned above. Change in sequence of DIs will not be acceptable.
11.6.2	Configuration and	DO-1 – CB Open

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	wiring of DOs of protection relays for executing SCADA commands through SCADA interface port (refer clause 12.1.5).	DO-2 – CB Close DO-3 – Line Isolator Open DO-4 – Line Isolator Close DO-5 – Bus 1 Isolator Open DO-6 – Bus 1 Isolator Close DO-7 – Bus 2 Isolator Open DO-8 – Bus 2 Isolator Close Sequence of DOs should be strictly as mentioned above. Change in sequence of DOs will not be acceptable.
11.6.3	Looping	All relays should be looped to form a common bus for interfacing with SCADA.
11.7	Transformer Monitoring Cum AVR Relay	
11.7.1	Functions	As per annexure –A
11.7.2	Requirement	To be provided in Transformer CRP (Take off price to be mentioned in price bid)
11.8	General Features of Auxiliary Relays	
11.8.1	Type	Static or electromechanical.
11.8.2	Reset Characteristic	Self reset contacts except for lockout relays.
11.8.3	Operation Indicators	(a) Hand reset operation indicators or LEDs with pushbutton for resetting. (b) Resetting of LEDs shall be possible from SCADA
11.8.4	Lockout relay	Manual and Electrical reset type
11.8.5	Operational Data	Bidder shall provide the reference list of the type of relays offered
11.8.6	Spare Contacts	Minimum 1NO and 1NC. To be wired upto the terminal block.
11.9	Auxiliary relays – Panel wise requirement	
11.9.1	Lockout relay	To be provided in all panels
11.9.2	DC fail relay	
11.9.3	AC fail relay	
11.9.4	Trip circuit supervision relay	To be provided in all panels for supervision of two trip coils.
11.9.5	Bistable Relays	To be provided in all panels for multiplication of auxiliary contact of breakers, isolators and earth switches. Multiplied contacts to be used for interlocks, indications and numerical relay input. 2NO + 2NC contacts shall be spare after multiplication in each case.
11.9.6	PT selection relays	To be provided in all panels as per scheme requirement.
11.9.7	Contact Multiplication relay	a. To be provided in all panels b. SCADA Close and Open Command shall be wired

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		up through CMR to Closing and Tripping circuit
11.9.8	Transformer Trouble Relays	Auxiliary relays with indicating flags (contactors will not be accepted) should be provided in transformer panel for the following trip and alarm commands – (a) Buchholz trip (b) OSR trip (c) PRV trip (d) SPR trip (e) WTI Trip (f) OTI Trip (g) OLTC PRV Trip (h) Buchholz Alarm (i) Low oil level alarm (j) OTI Alarm (k) WTI Alarm.
11.9.9	Transformer Trouble Relay Contact Multiplication	(a) Contact multiplication of Transformer trouble relays shall be provided with 2 NO and 2 NC contact as spare. (b) 1 NO contact of Buchholz, Differential, OSR, PRV, SPR, REF contact multiplication relay for NIFPS (Nitrogen Injection fire protection system) shall be provided.
11.9.10	SF6 low and SF6 lockout relay	To be provided in all 66kV control and relay panels
11.9.11	DC selection scheme	Fed by two DC incoming sources in Bus coupler panel with auto changeover facility
11.10	General Requirements for all relays/contactors	
11.10.1	Auxiliary supply	(a) 48-250 VDC. All relays/contactors shall be suitable for continuous operation at 15% overvoltage and 15% under voltage. (b) No external resistor shall be provided in relays /contactor to achieve desired voltage.
11.10.2	Spare contacts	Shall be wired upto the terminal block
11.10.3	Signal Integration	All signal integration shall only be through NO Contact

**12.0 SYNCH CHECK PHILOSOPHY**

12.1	Dead Bus – Live Line	(a) Application - Required for Charging of Bus from Line Supply (b) Logic - Sync check relay installed on line panel will check the line and bus voltage and derive that the line is live and bus is in dead condition i.e bus has to be charged by the line breaker. Hence Sync check relay will allow the line breaker to close in this
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		condition.
12.2	Dead Line – Live Bus	<p>(a) Application - Required for Charging of Line from Bus Supply</p> <p>(b) Logic - Sync check relay installed on line panel will check line and bus voltage and derive that the line is dead and bus is in live condition i.e line has to charged from bus. Hence Sync check relay will allow the line breaker to close in this condition.</p>
12.3	Live Bus – Live Line	<p>(a) Application - Required for paralleling of bus and line supply</p> <p>(b) Logic - Sync check relay installed on line panel will compare magnitude and phase sequence of line and bus voltages. If the variations are within the range set in the relay, sync check relay will allow the closing of line breaker.</p>
12.4	Live Bus – Dead Bus	<p>(a) Application – Required for charging of dead bus through another live bus.</p> <p>(b) Logic – Sync check relay installed on bus coupler/bus section panel will check voltage of both buses and derive that one bus is dead and other bus is live i.e dead bus is being charged from live bus. Hence Sync check relay will allow the bus coupler/bus section breaker to close in this condition.</p>
12.5	Live Bus – Live Bus	<p>(a) Application – Required for paralleling of two buses/bus sections.</p> <p>(b) Logic – Sync check relay installed on bus coupler/bus section panel will compare the magnitude and phase sequence of voltage of both buses (or bus sections). If the variations are within the range set in the relay, sync check relay will allow the bus coupler/bus section breaker to close.</p>

### 13.0 MANAGED ETHERNET SWITCH

13.1	Ethernet Switch	
13.1.1	Numbers	Two at each site
13.1.2	FO Port	Minimum 16 Nos
13.1.3	RJ 45 Port	4 Nos
13.1.4	Communication Protocol	IEC 61850
13.1.5	Network Protocol	PRP
13.1.6	Downlink Rate	100 MBPS

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13.1.7	Uplink Rate	1 GBPS
13.1.8	Coating	Conformal
13.1.9	Power Supply Voltage	220 / 50 VDC as per site condition
13.1.10	Grade	Industrial
13.1.11	Certification required	KEMA,CE & FCC for IEC 61850 compliance
13.1.12	Operating Temperature	
13.1.13	Mounting	In Switchgear Panel
13.1.14	Blinking LED Indicators	On each RJ45 ports
13.1.15	Separate Maintenance/console Part	Required
13.1.16	Latency	Less than or equal to 10 ms
13.1.17	Fibre Optic Compatibility	Multimode, 1310 nm
13.1.18	Placement	Din Rail Arrangement Inside Switchgear
13.2	Fibre Optics (Patch Cord) and Ethernet cable	
13.2.1	Connection	From Relays, Meters to Ethernet Switch
13.2.2	Mode of Fibre Optics	Multimode
13.2.3	Wavelength	1310 nm
13.2.4	Ethernet Cable Type	CAT VI
13.2.5	Associated Connectors and Accessories	Required

**14.0 ANNUNCIATION**

14.1	Type	Static type alongwith alarm. Annunciations shall be repetitive type and shall be capable of registering the fleeting signal. Fascia test facility should also be provided.
14.2	Mounting	Flush mounted
14.3	Fascia	16 window
14.4	Signals to provided on Fascia	Window 1 – Main Protection Operated ( Distance /Differential) Window 2 – Backup O/C & E/F Protection Operated Window 3 – CBFP operated Window 4 – CB Autotrip Window 5 – SF6 Low/SF6 Lockout (For 66kV CRP only) Window 6 – Trip Circuit Unhealthy Window 7 – DC Fail Window 8 – AC Fail Window 9 – VT Fuse Fail Window 10 – Protection Relay/Trip relay Faulty Window 11 – Tarfo Trouble trip (For trafo panel only)

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		Window 12 – Trafo Trouble alarm (For trafo panel only)
14.5	Push Buttons	For test, accept and reset
14.6	Potential Free Contacts	To be provided for event logger
14.7	Alarm	For all signals wired to the annunciator
14.8	Overall Dimension of Group	To be Provided by Vendor

Sequence of operation of the annunciator shall be as follows-

S No.	Alarm Condition	Fault Contact	Visual Annunciation	Audible Annunciation
a.	Normal	Open	Off	Off
b.	Abnormal	Close	Flashing	On
c.	Accept	Close	Steady on	Off
d.	Return to normal	Open	Steady On	Off
e.	Reset	Open	Off	Off
f.	Reset before return to normal	Close	Flashing	On

**15.0 INDICATIONS**

15.1	Indicating Lamps	Flush mounted Clustered LED type with rear terminal connections. Lamp Cover to be screwed type and moulded from heat resistant material
15.1.1	Breaker On	Red
15.1.2	Breaker Off	Green
15.1.3	Isolator Close	Red
15.1.4	Isolator Open	Green
15.1.5	Spring Charged	Blue
15.1.6	DC control supply healthy	Amber
15.1.7	Heater circuit healthy	Yellow
15.1.8	Trip circuit healthy	White
15.1.9	PT supply	R, Y, B
15.1.10	Voltage	220VDC/50 VDC
15.1.11	Rating	To be Provided by Vendor
15.1.12	Wattage	To be Provided by Vendor

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15.1.13	Series Resistance	To be Provided by Vendor
15.1.14	10% extra Lamp Furnished?	To be Provided by Vendor
15.1.15	Size of lens	To be Provided by Vendor
15.1.16	Make	To be Provided by Vendor
15.1.17	Type	To be Provided by Vendor
15.2	Semaphores	To be provided for all earth switches.
15.2.1	Make	To be Provided by Vendor
15.2.2	Type	To be Provided by Vendor
15.2.3	Diameter of the Disc	To be Provided by Vendor
15.2.4	Operating voltage	220VDC/50 VDC
15.2.5	Burden (Watt DC)	To be Provided by Vendor
15.2.6	Whether latch in type or supply Failure type	To be Provided by Vendor

**16.0 SELECTOR SWITCHES AND PUSH BUTTONS**

16.1	Switches	Flush Mounted with shrouded terminals
16.1.1	TNC Switch	Lockable Pistol Grip type with spring return to normal position
16.1.2	Local/SCADA selector switch	2 pole
16.1.3	Rotary On/Off Switches	For heater/illumination circuit
16.1.4	Rating of switches	16 A
16.2	Push buttons	Flush Mounted with shrouded terminals
16.2.1	Accept Push Button	Black Color- Trip alarm/DC fail alarm
16.2.2	Reset Push Button	Yellow Color- Trip alarm/DC fail alarm
16.2.3	Test Push Button	Blue Color
16.2.4	Rating	10A

**17.0 ACCESSORIES**

17.1	Space heaters	Thermostat controlled with switch for isolation
17.1.1	Voltage	240 V AC

**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

17.1.2	Wattage	To be provided by Vendor
17.1.3	Thermostat Range	To be provided by Vendor
17.1.4	Provided with Individual fuse unit	To be provided by Vendor
17.2	Socket and switch	240V, 5/15A universal type socket to be provided in each panel with on-off switch
17.3	MCBs and Fuses	Provision for receiving, distribution, isolation and fusing of DC and AC supplies to various control circuits should be made using MCBs and Fuses of appropriate ratings
17.4	Panel illumination	240V AC illumination lamp controlled by panel door switch to be provided in each panel

**18.0 APPROVED MAKES OF COMPONENTS**

18.1	Numerical Relays	(a) R Series of ABB (b) Siprotec series of Siemens (c) Micom series(PX40) of Schneider (d) Micom Series of GE (e) All numerical relays in a panel should be of same make. Use of two different makes of relays in a panel is not acceptable.
18.2	Trafo Monitoring Cum AVR relay	A-Eberle/Easun MR
18.3	Auxiliary Relays & Contact Multiplication Relays	Alstom/Schneider/ABB/Siemens/ER
18.4	Miniature Relays	ABB/ OMRAN
18.5	Contactors	ABB/Siemens/Schneider
18.6	MCBs	Siemens/Schneider/Legrand/ABB
18.7	Control switches	Switron/Kaycee
18.8	Annunciator	Minilec/Alan
18.9	Test terminal block	IMP/DAV
18.10	Terminal blocks	Elmex/Connectwell
18.11	Indicating lamps	Siemens/ Teknic/ Binay
18.12	Meters	Rishabh/Conzerv
18.13	Multi Function Meter	Rishabh (Rish Delta Energy)
18.14	Managed Ethernet Switch	Ruggedcom/ Hirschman/ GarrettCom



**19.0 QUALITY ASSURANCE, INSPECTION & TESTING**

19.1	Vendor quality plan	To be submitted for purchaser approval
19.2	Type tests	Product must be type tested as per Indian Standards or IEC
19.3	Type test report validity	Last five years from the date of bid submission
19.4	Acceptance and Routine tests	As per specifications and relevant standards. Charges of these tests shall be deemed to be included in the equipment price. Purchaser reserves the right to witness all the tests.
19.5	Notice to Purchaser for conducting tests	Atleast three weeks in advance
19.6	Test reports of acceptance and routine test before dispatch	Six copies to be submitted.

**20.0 DEVIATIONS**

Deviation from this specification shall be stated in writing with the tender by reference to the specification clause/ GTP/ Drawing and description of alternative offer. In absence of such a statement, it shall be assumed by the buyer that the seller complies fully with this specification.

**21.0 DRAWINGS AND DATA SUBMISSION MATRIX**

- Document checklist for each stage is given in table below. (Refer equipment specification for details)
- Document check sheet compliance shall be the first sheet for each submission stage i.e. Technical bid, Drawing Approval, Pre Dispatch, Pre closure.
- No submission is acceptable without check list compliance.
- Deficient/ improper document/ drawing submission shall be liable for rejection.
- Order of documents shall be strictly as per the check list with in Soft copy with separate folder in proper nomenclature.
- Any drawing not included in the below table but necessary for detailed engineering shall be deemed to be included in bidder's scope.

**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

<b>S. No</b>	<b>Head</b>	<b>Bid</b>	<b>Drawing Approval</b>	<b>Pre Dispatch</b>	<b>Pre Closure</b>
21.1	Contact Person Name, Email ID and Mobile Number	Required			
21.2	Consolidated Deviation Sheet	Required	Required		
21.3	GTP	Required	Required		
21.4	Relevant Type Test as per IS/IEC	Required			
21.5	Manufacturer's quality assurance plan and certification for quality standards		Required		
21.6	Sizing Calculation of Associated Equipment		Required		
21.7	Recommended Spares Apart from spares stated in Spec(for five years of operation)		Required		
21.8	Schematic		Required		
21.9	CRP				
21.9.1	General Arrangement	Required	Required		
21.9.2	Sectional Layout		Required		
21.9.3	Door Layout		Required		
21.9.4	Panel wise BOQ		Required		
21.9.5	Index Sheet		Required		
21.9.6	Symbols		Required		
21.9.7	SLD	Required	Required		
21.9.8	Trip Logic		Required		
21.9.9	AC Distribution Circuit		Required		
21.9.10	DC Distribution Circuit		Required		
21.9.11	CT Distribution Circuit		Required		
21.9.12	VT Distribution Circuit		Required		
21.9.13	Voltage Selection Circuit		Required		
21.9.14	Metering Circuit		Required		
21.9.15	Indication Circuit		Required		

**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

<b>S. No</b>	<b>Head</b>	<b>Bid</b>	<b>Drawing Approval</b>	<b>Pre Dispatch</b>	<b>Pre Closure</b>
21.9.16	Isolator Control Circuit		Required		
21.9.17	Protection Circuit		Required		
21.9.18	Relay Circuit with DI and DOs		Required		
21.9.19	DI and DO Sheet of each relay		Required		
21.9.20	Schematic Circuit diagram and Scheme of Each type of Panel		Required		
21.9.21	Logic Operation Diagram		Required		
21.9.22	Communication Architecture		Required		
21.9.23	Trafo Monitoring Relay Circuit in case of Transformer Panel		Required		
21.9.24	CB Closing interlock circuit		Required		
21.9.25	Tripping Circuit		Required		
21.9.26	CB status & CB trouble cont. mult. circuit		Required		
21.9.27	Isolator , E/S and trafo trouble contact multiplication circuit		Required		
21.9.28	Annunciation circuit		Required		
21.9.29	TB Reference page		Required		
21.9.30	Synch Logic Diagram		Required		
21.9.31	QAP		Required		
21.10	Inspection Reports			Required	
21.11	As manufacturing Drawings			Required	
21.12	Operation and Maintenance Manual			Required	Required
21.13	Trouble shooting manual			Required	Required
21.14	As built Drawings				Required
21.15	Test Report				Required
21.16	Soft Copy				
21.16.1	In Pen drive	Required			

S. No	Head	Bid	Drawing Approval	Pre Dispatch	Pre Closure
21.16.2	Through Mail		Required	Required	Required

## 22.0 PACKING

22.1	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration. During transportation/ transit and storage, panels may be subjected to outdoor conditions. Hence, packing of each panel shall be weatherproof.
22.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
22.3	Packing Identification Label to be provided on each packing case with the following details	
22.3.1	Individual serial number	
22.3.2	Purchaser's name	
22.3.3	PO number (along with SAP item code, if any) & date	
22.3.4	Equipment Tag no. (if any)	
22.3.5	Destination	
22.3.6	Project Details	
22.3.7	Manufacturer / Supplier's name	
22.3.8	Address of Manufacturer / Supplier / it's agent	
22.3.9	Description and Quantity	
22.3.10	Country of origin	
22.3.11	Month & year of Manufacturing	
22.3.12	Case measurements	
22.3.13	Gross and net weights in kilograms	
22.3.14	All necessary slinging and stacking instructions	

**23.0 SHIPPING**

23.1	<b>Shipping</b>	<p>The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, Overhead lines, free access etc. from the Manufacturing plant to the project site. Bidder shall furnish the confirmation that the proposed Packages can be safely transported, as normal or oversize packages, up to the site. Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.</p> <p>The seller shall be responsible for all transit damage due to improper packing.</p>
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**24.0 HANDLING AND STORAGE**

24.1	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.
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**25.0 ANNEXURE – A – TRANSFORMER MONITORING CUM AVR RELAY**

25.1	<b>General features</b>	
25.1.1	Technology and Functionality	Microprocessor based with provision for multifunction control and monitoring.
25.1.2	Mounting	Rack Mounting

**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

25.1.3	Architecture	Hardware and software architecture shall be modular and disconnectable to adapt the control unit to the required level of complexity as per the application.
25.1.4	Programming and configuration	AVR shall utilize a user friendly setting and operating multi-lingual software in windows environment with menus and icons for fast access to the data required.
25.1.5	User Machine Interface	UMI with an alphanumeric key pad and graphical LCD display with backlight indicating measurement values and operating messages. Capability to access and change all settings and parameters.
25.1.6	PC Interface port	Front port (preferably serial) for configuration using PC. Cost of licensed software and communication cord, required for programming of offered protection relays using PC, shall be mentioned separately in the bid.
25.1.7	SCADA Interface port	LC Type Dual fibre optic port for interfacing with SCADA on PRP protocol. Through this port relays shall be connected to Ethernet switches.
25.1.8	Communication protocol	Relays shall be compatible for interfacing with SCADA on both IEC61850 and IEC103 (Data Type-9) protocol. Communication protocol shall be selectable at site. Relay shall be capable of transmitting all parameters including measured values, DI, DO, AI, Events and fault records to SCADA.
25.1.9	Self diagnosis	Relay shall be able to detect internal failures and same shall be transmitted to SCADA as a soft signal. A watchdog relay with changeover contact shall provide information about the failure.
25.1.10	Cable Termination	Termination of cable shall be at rear side.
25.1.11	Time Synchronization	Relay shall be capable of being synchronized with the system clock through SCADA , PC and GPS.
25.1.12	Auxiliary supply	220VDC or 48VDC
25.2	<b>Inputs and Outputs</b>	
25.2.1	CT Input	1/5A selectable through programming
25.2.2	PT Input	110VAC
25.2.3	Binary Inputs	Sixteen programmable binary inputs should be provided
25.2.4	Analog Inputs (4-20mA)	One input to be provided
25.2.5	PT-100 direct input	One input to be provided
25.2.6	Direct Resistance Input	For tap position indication (18 steps)

**TECHNICAL SPECIFICATION FOR 66/33KV CONTROL AND RELAY PANEL**

25.2.7	Binary Outputs	Ten programmable binary outputs should be provided
25.3	<b>Control</b>	
25.3.1	Control Tasks	Ability to implement control functions through programmable logics
25.3.2	Voltage setting	Programmable Voltage set point
25.3.3	Voltage Regulation	Raise/Lower tap position to maintain the preset value of voltage.
25.3.4	Voltage Regulation modes	Automatic and Manual
25.3.5	Operation Modes	Local and Remote
25.3.6	Fan and Pump control	To be provided
25.3.7	Transformer Paralleling	Capability to parallel transformers whose AVR's are interconnected via a communication network.
25.4	<b>SCADA Interfacing</b>	
25.4.1	Configuration of DIs for routing alarm/trip signals to SCADA.	DI-1 – Buchholz trip DI-2 – OSR Trip DI-3 – PRV trip DI-4 – SPR trip DI-5 – OTI trip DI-6 – WTI trip DI-7 – Buchholz alarm DI-8 – Oil Level low larm (MOG alarm) DI-9 – WTI alarm DI-10 – OTI alarm DI-11 – Tap changer trouble/stuck/out of step DI-12 – Tap changer motor supply fail DI-13 – Tap changer in local control All signals from DI-1 to DI-10 are to be wired up from transformer trouble auxiliary relays.
25.4.2	Configuration of DOs for executing commands from SCADA through interface port/CRP	DO-1 – Tap raise DO-2 – Tap lower DO-3 – Fan group 1 control DO-4 – Fan group 2 control
25.4.3	Analog Inputs	All analog inputs shall be SCADA Compatible
25.5	<b>Measurement, Event Recording and Monitoring</b>	
25.5.1	Measured Quantities (optional)	Voltage, Current, Active Power, Reactive Power, Apparent Power, Power factor, frequency
25.5.2	Event Recording	Facility for recording parameters during various events such as tap change, change in binary input status etc.

25.5.3	Monitoring	Capability to monitor important transformer parameters such as Oil temperature, Winding Temperature etc and give indication/alarm when the value of a particular parameter exceeds the preset value.
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## 26.0 ANNEXURE- B – GUARANTEED TECHNICAL PARTICULARS

Vendor must submit clause wise compliance against specification at the time of drawing approval clearly highlighting the deviations from specification against each clause.

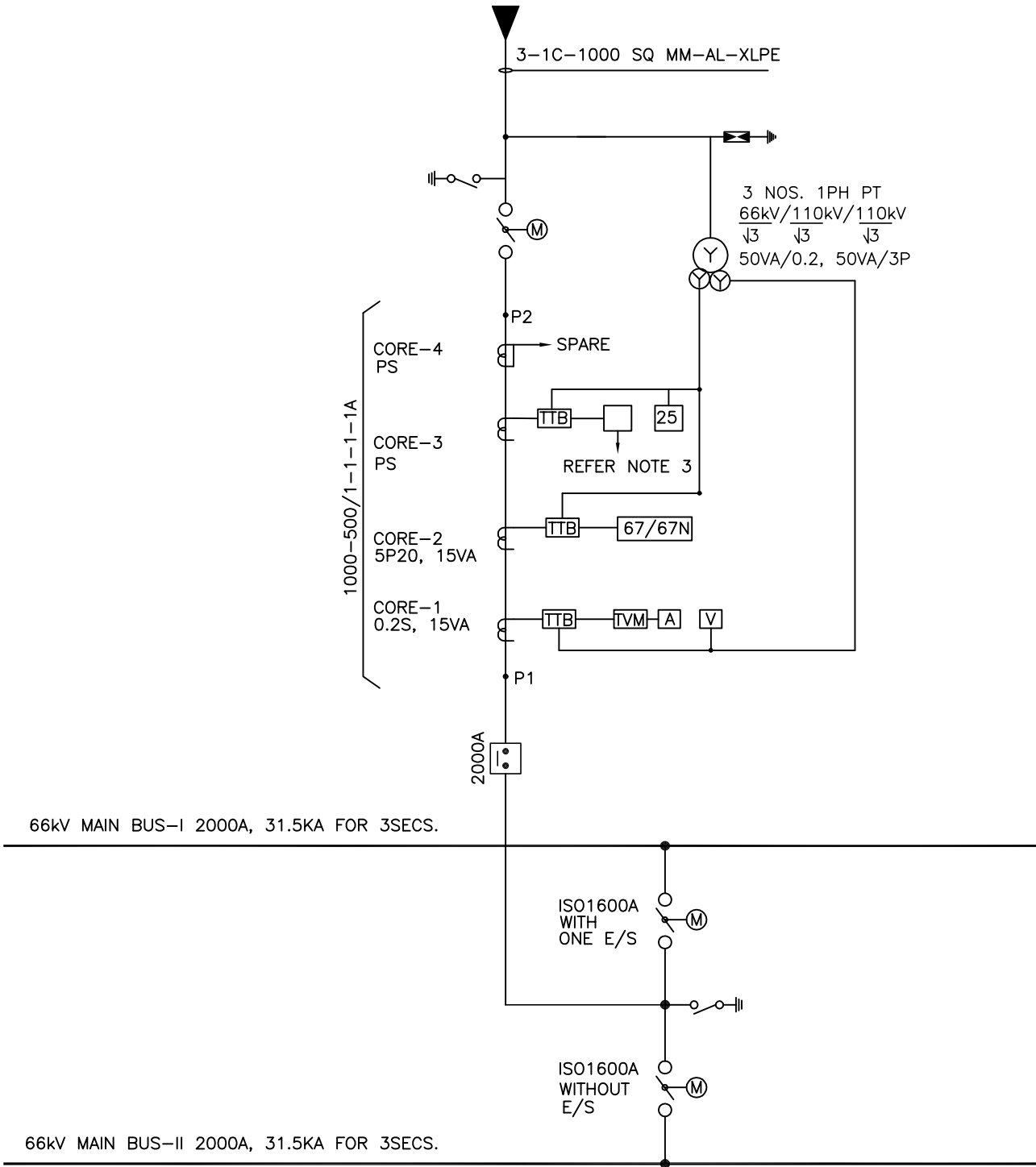
## 27.0 ANNEXURE- C – SPARES REQUIREMENT

S No.	Description	Unit Rate
27.1	Numerical relay of each type	1 nos.
27.2	Auxiliary relay of each type	1 nos.
27.3	Contact multiplication relays (Bistable type for CB, isolator and earth switch auxiliary contact multiplication)	6 nos.
27.4	Contactors of each rating	2 nos.
27.5	Voltmeter	1 nos.
27.6	Local/Remote Selector switch	1 nos.
27.7	TNC switch for CB	2 nos.
27.8	TNC switch for Isolators	3 nos.
27.9	Semaphore indicators	4 nos.
27.10	MCB of each rating	1 nos.

## 28.0 ANNEXURE-D-SLDs



# ANNEXURE – D1



### LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

- NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.  
3. LINE DIFFERENTIAL OR DISTANCE RELAY AS PER CLAUSE 11.2.1 OF SPECIFICATION

DRAWN	AH/AM	TITLE:-
CHECKED	SG/AS	TYPICAL 66KV LINE SLD
APPD.	GS/GN	
DATE	03.06.22	
SCALE	NTS	

BSES

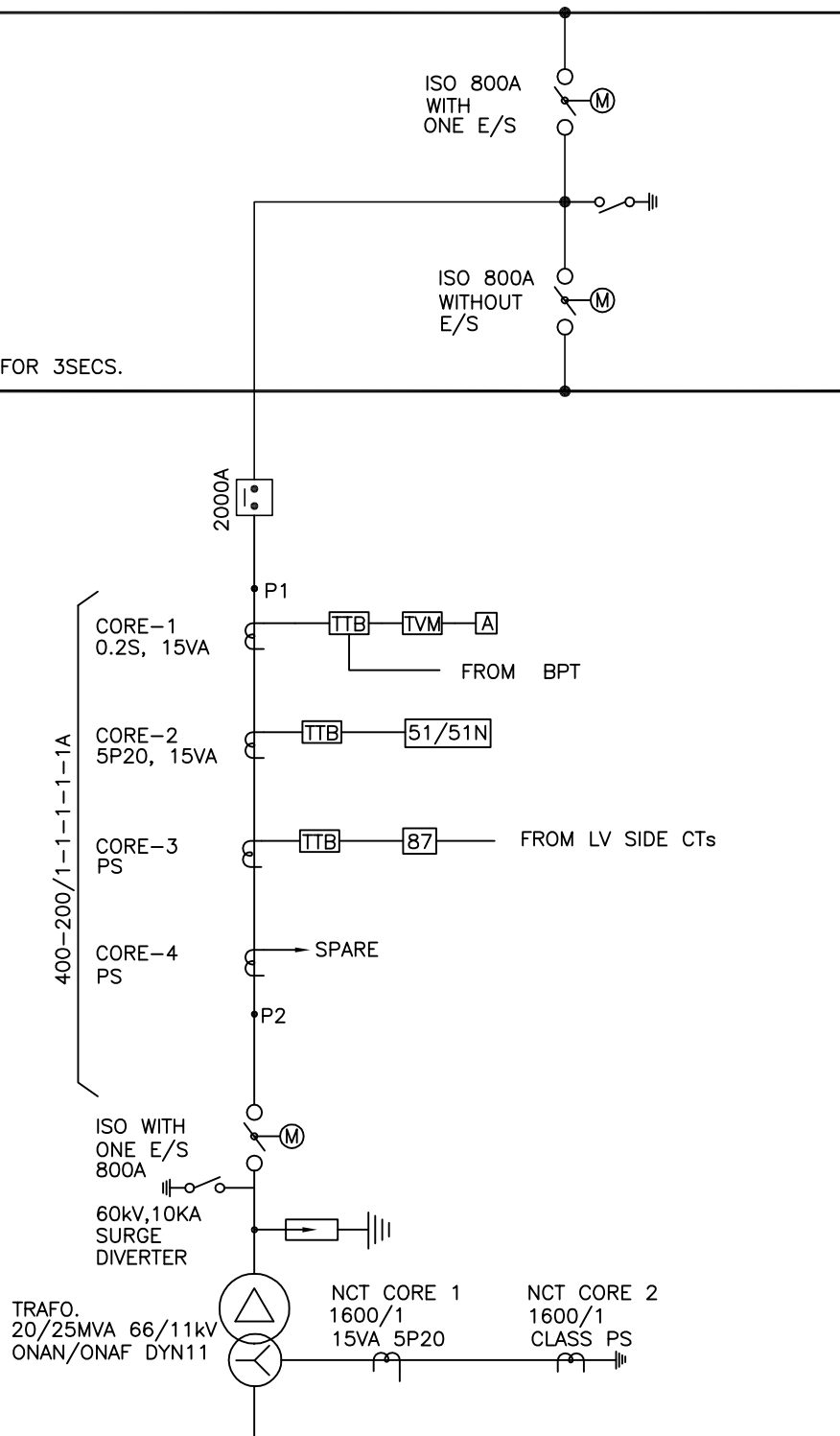
SPEC No - BSES-TS-86-CRP-RO

DWG No.:- SLD-CRP-66KV-01

# ANNEXURE-D2

66kV MAIN BUS-I 2000A, 31.5KA FOR 3SECS.

66kV MAIN BUS-II 2000A, 31.5KA FOR 3SECS.



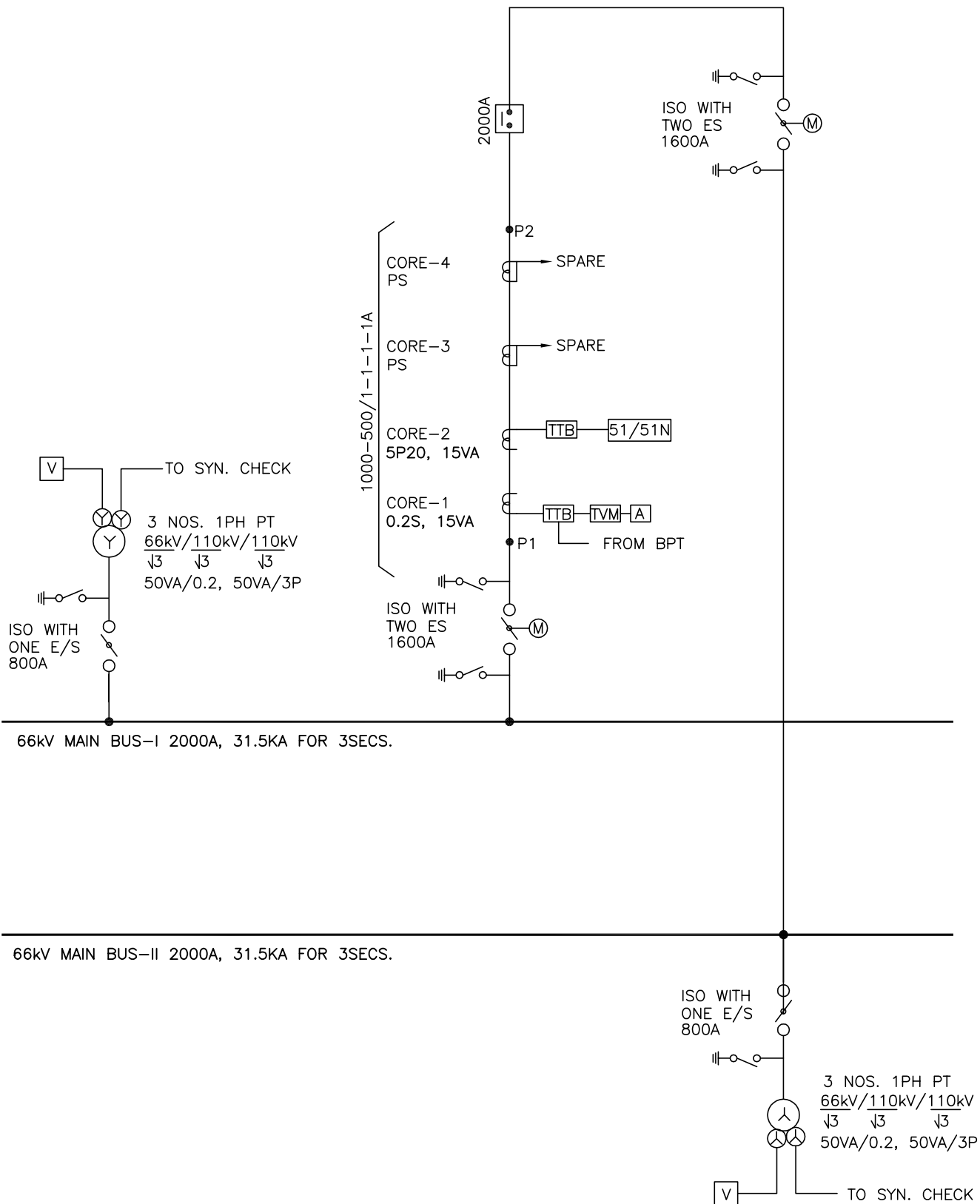
**LEGEND**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

DRAWN	AH/AM	TITLE:-	<b>BSES</b>
CHECKED	SG/AS	TYPICAL 66/11KV	
APPD	GS/GN	TRANSFORMER FEEDER SLD	
DATE	03.06.22		
SCALE	NTS		SPEC No - BSES-TS-86-CRP-RO
			DWG No.:- SLD-CRP-66KV-02

# ANNEXURE-D3



**LEGEND**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

DRAWN	AH/AM	TITLE:-
CHECKED	SG/AS	TYPICAL 66KV BUSCOUPLER SLD
APPD	GS/GN	
DATE	03.06.22	
SCALE	NTS	

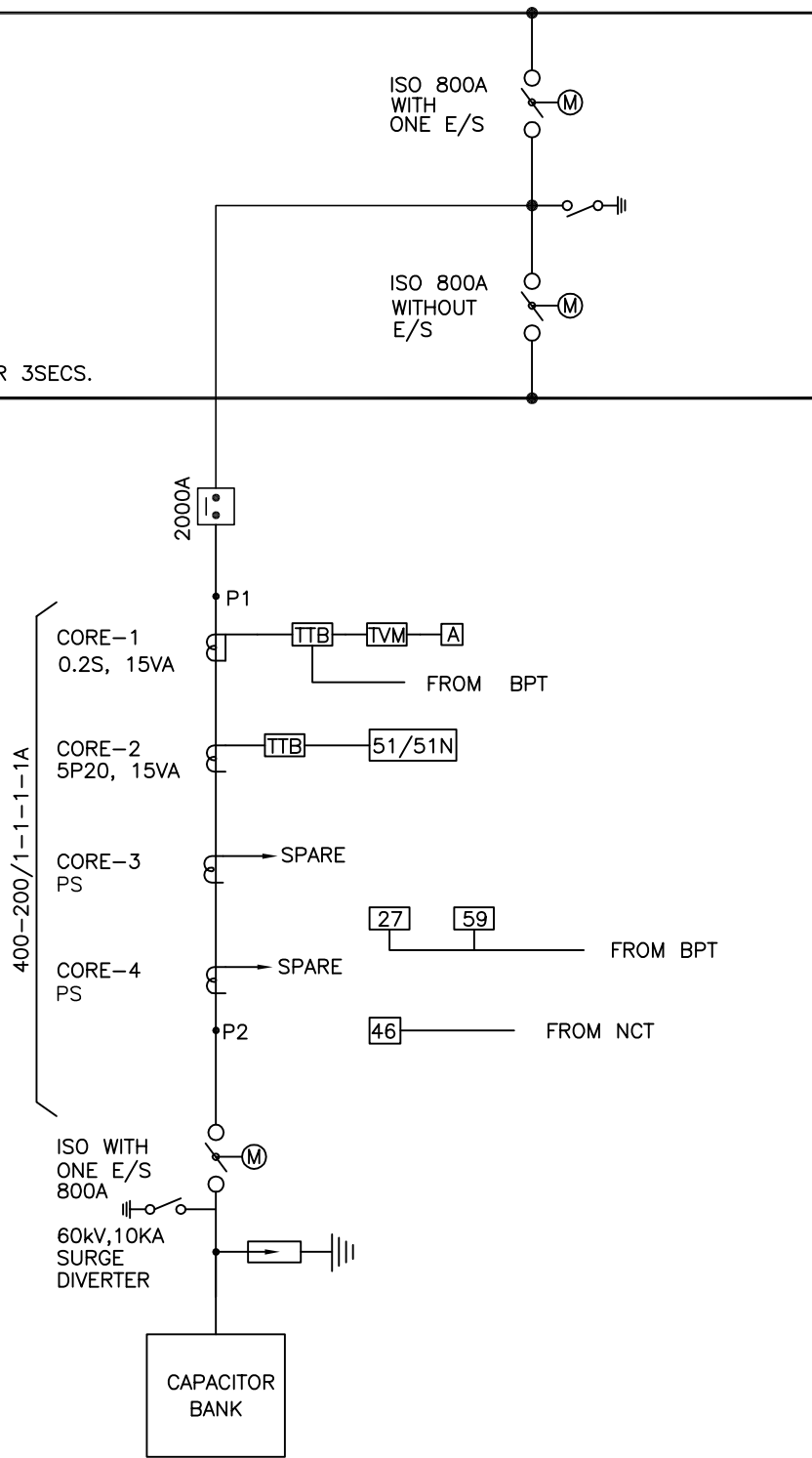
BSES

SPEC No - BSES-TS-86-CRP-RO  
DWG No.:-SLD-CRP-66KV-03

# ANNEXURE-D4

66kV MAIN BUS-I 2000A, 31.5KA FOR 3SECS.

66kV MAIN BUS-II 2000A, 31.5KA FOR 3SECS.



**LEGEND**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

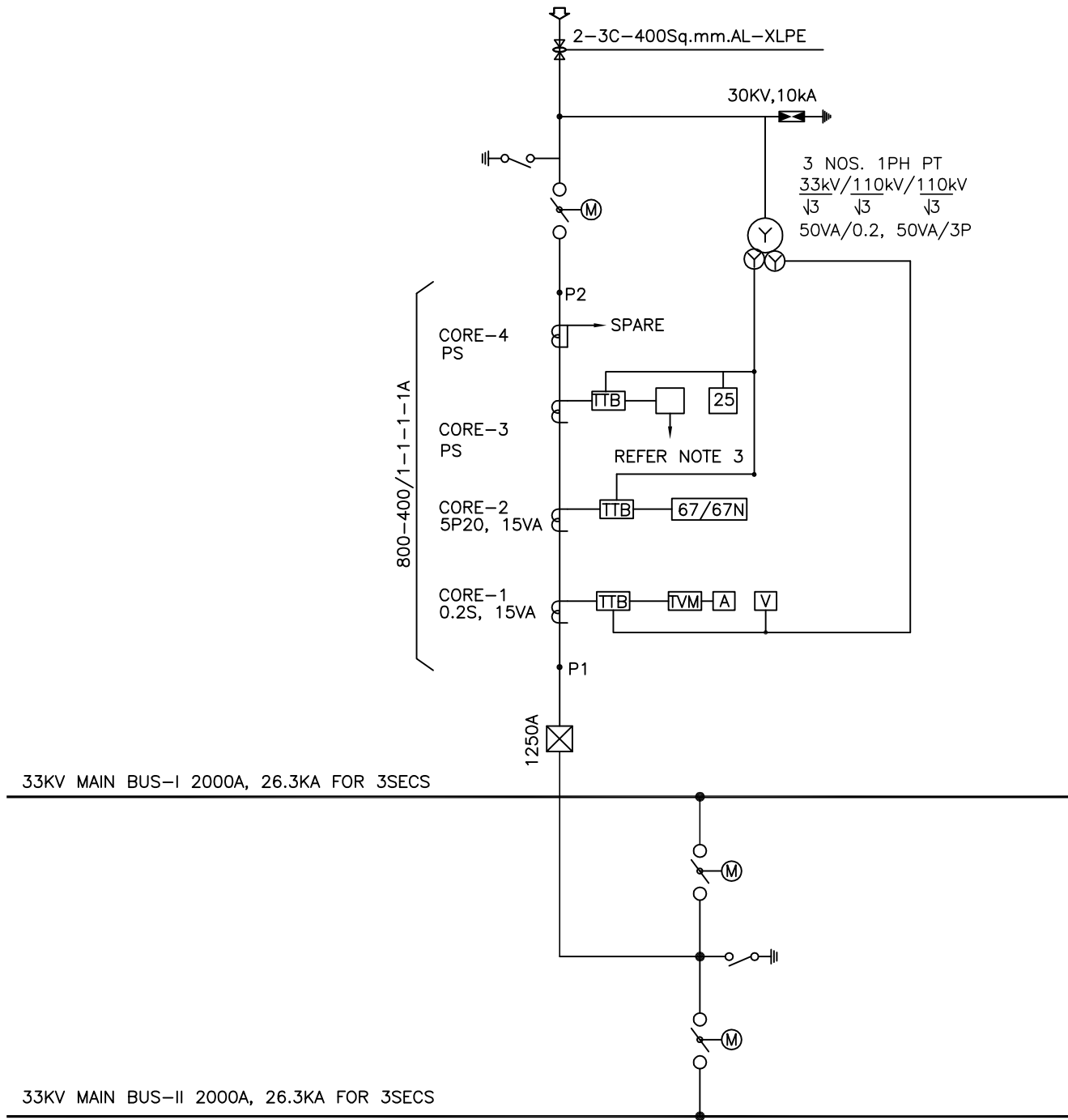
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CHECKED	SG/AS	TYPICAL 66KV
APPD	GS/GN	CAPACITOR BANK FEEDER
DATE	03.06.22	SLD
SCALE	NTS	



SPEC No - BSES-TS-86-CRP-RO

DWG No.: -SLD-CRP-66KV-04

# ANNEXURE-D5



## LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

- NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
 2. TVM IS NOT IN SUPPLIER'S SCOPE.  
 3. LINE DIFFERENTIAL OR DISTANCE RELAY AS PER CLAUSE 11.2.1 OF SPECIFICATION.

DRAWN	AH/AM	TITLE:-
CHECKED	SG/AS	TYPICAL SLD FOR
APPD	GS/GN	33KV INCOMER/OUTGOING
DATE	03.06.22	
SCALE	NTS	

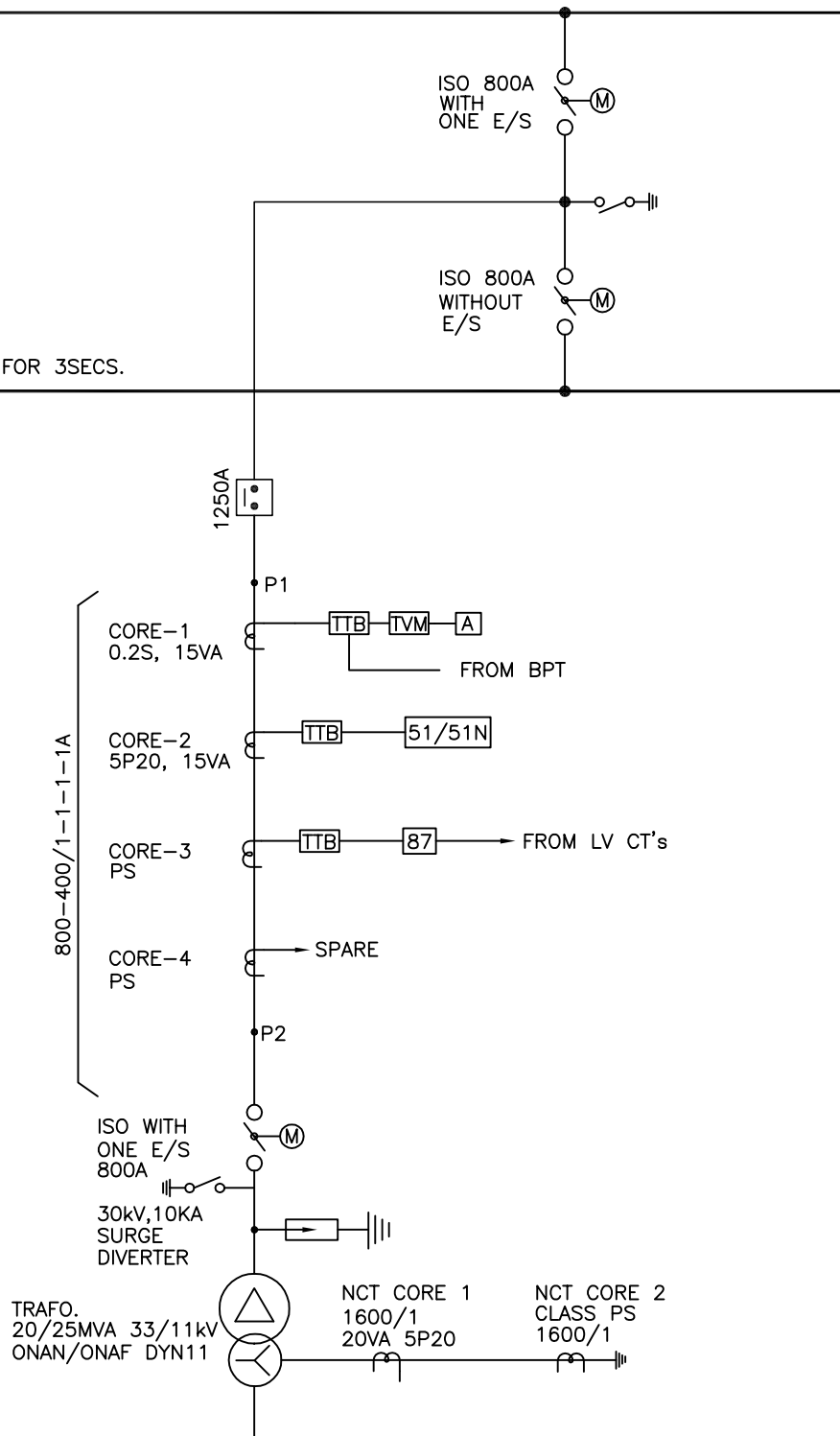
**BSES**

SPEC No - BSES-TS-86-CRP-RO  
 DWG No.: -SLD-CRP-33KV-01

# ANNEXURE-D6

33kV MAIN BUS-I 2000A, 26.3KA FOR 3SECS.

33kV MAIN BUS-II 2000A, 26.3KA FOR 3SECS.



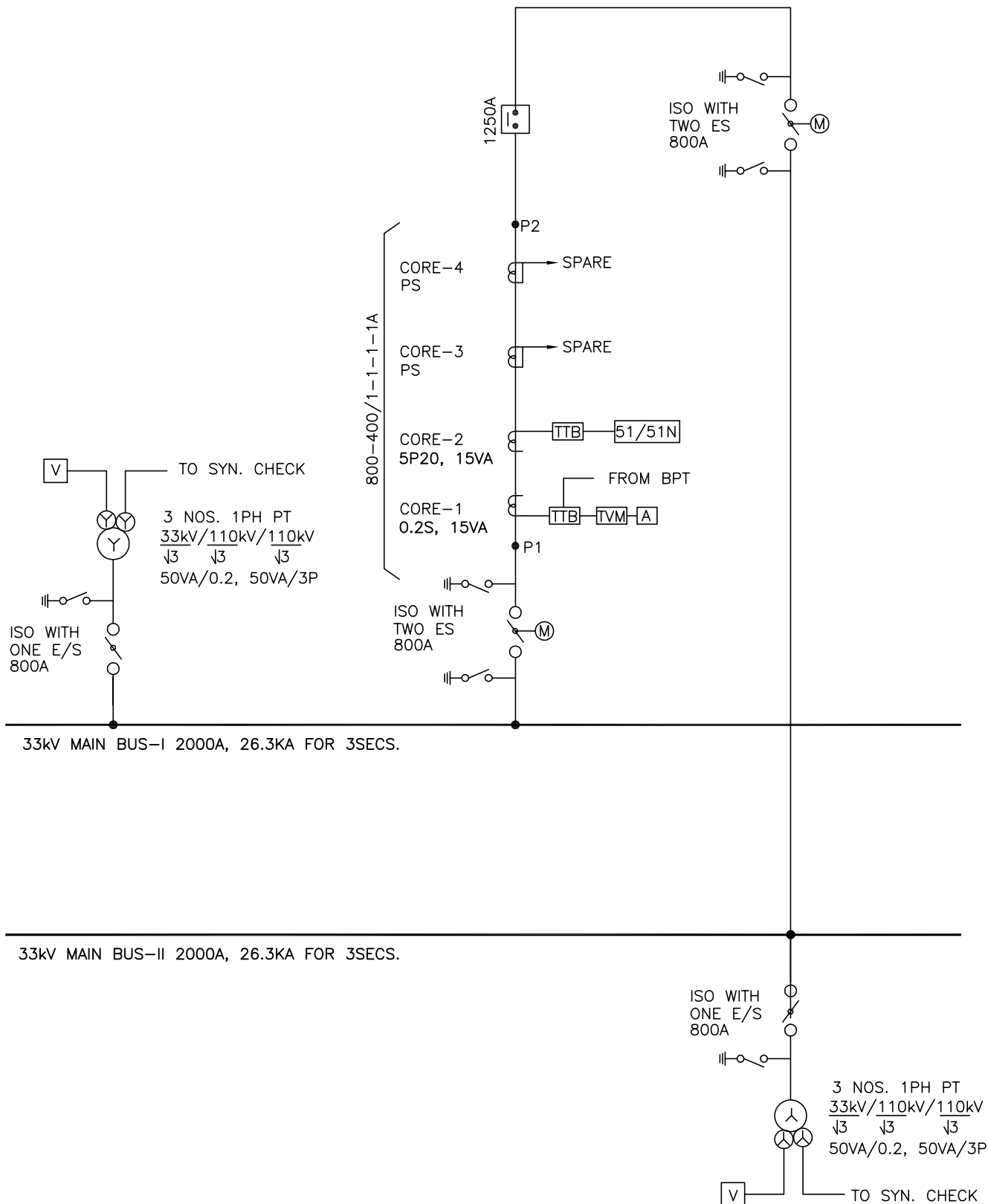
**LEGEND**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

DRAWN	AH/AM	TITLE:-	<b>BSES</b>
CHECKED	SG/AS	TYPICAL 33/11KV	
APPD	GS/GN	TRANSFORMER FEEDER SLD	
DATE	03.06.22		
SCALE	NTS		SPEC No - BSES-TS-86-CRP-RO
Page 110 of 305			DWG No.: - SLD-CRP-33KV-02

# ANNEXURE-D7



### LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRVEKTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

DRAWN	AH/AM	TITLE:-
CHECKED	SG/AS	TYPICAL 33KV BUSCOUPLER SLD
APPD	GS/GN	
DATE	03.06.22	
SCALE	NTS	

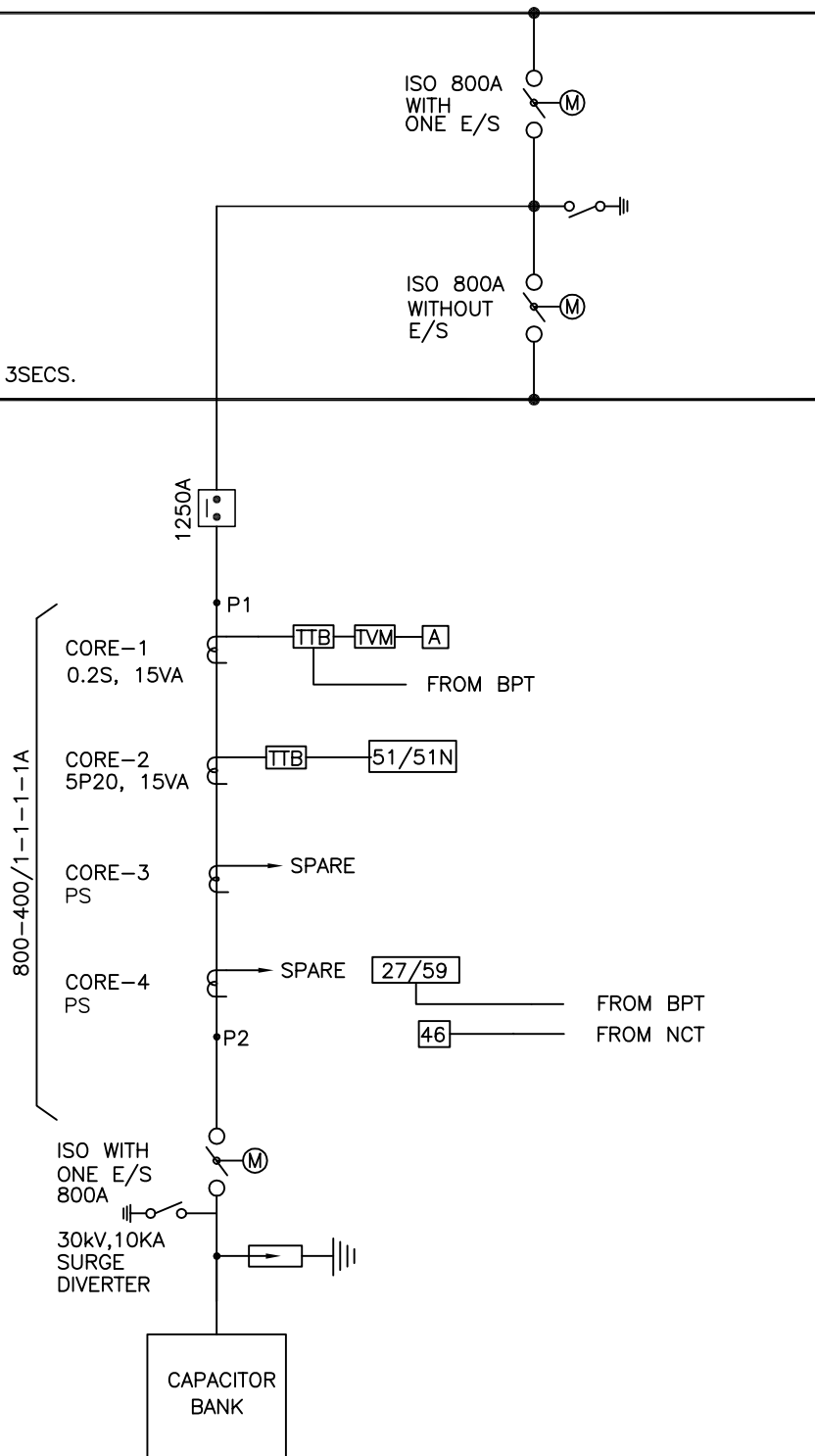
## BSES

SPEC No - BSES-TS-86-CRP-RO  
DWG No.: - SLD-CRP-33KV-03

# ANNEXURE – D8

33kV MAIN BUS-I 2000A, 26.3KA FOR 3SECS.

33kV MAIN BUS-II 2000A, 26.3KA FOR 3SECS.



**LEGEND**

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOTORISED ISOLATOR WITH ONE E/S		TEST TERMINAL BLOCK
	MOTORISED ISOLATOR WITH DOUBLE E/S		O/C & E/F RELAY
	SURGE DIVERTER		DISTANCE RELAY
	CURRENT TRANSFORMER		U/V & O/V RELAY
	POTENTIAL TRANSFORMER		DIRECTIONAL O/C & E/F RELAY
	CIRCUIT BREAKER		DIFFERENTIAL RELAY
	VOLTMETER		NEUTRAL UNBALANCE RELAY
	AMMETER		SYNC CHECK
	TRIVECTOR METER		

NOTE; 1. REFER SPECIFICATION CLAUSE 11.0 FOR FUNCTIONAL DETAILS OF PROTECTION RELAYS.  
2. TVM IS NOT IN SUPPLIER'S SCOPE.

DRAWN	AH/AM	TITLE:-
CHECKED	SG/AS	TYPICAL 33/11KV
APPD	GS/GN	CAPACITOR BANK FEEDER
DATE	03.06.22	SLD
SCALE	NTS	



SPEC No - BSES-TS-86-CRP-RO  
DWG No.:-SLD-CRP-33KV-04



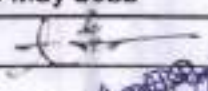
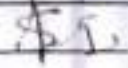
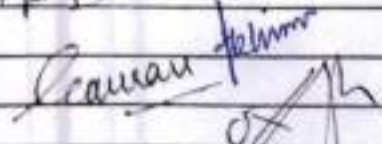
# BSES

## Technical Specification

For

### SMPS Based Battery Charger

Specification no – BSES-TS-73-SMPSBC-R0

Rev	0	
Page	1 of 11	
Date	05 May 2022	
Prepared by	Abhishek Harsh	
	Amar Singh	
Reviewed by	Srinivas Gopu	
	Abhinav Srivastava	
Approved by	Gaurav Sharma	
	Gopal Nariya	

**INDEX**

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**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER****1 SCOPE OF SUPPLY**

This specification covers the design, manufacturing, testing, supply, erection & commissioning of 20 VDC/ 50 VDC SMPS based 2X100% Float Cum Boost Charger at site for indoor installation with all necessary accessories associated with it.

Specification covers Type 1 and Type 2 Battery Charger. Type 1 Battery Charger is for Grid Substations while Type 2 Battery Charger is for BSES HT Customers.

**2 CODES & STANDARDS**

Material, equipment and methods used in the manufacture of battery charger shall confirm to the latest edition of following

Indian Electricity Rules	
Indian electricity act	
CBIP manual	
IS 3895	Specification for rectifier equipment in general
IS 5921	Printed circuit boards
IS 6619	Safety code for semiconductor devices
IS 4540	Semiconductor rectifier assemblies and equipment
IS 694	PVC Insulated Cables for Working Voltage up to and including 1100V
IS 1248	Direct Acting Electrical indicating instruments
IS 2705	Current transformer
IS 3156	Voltage transformer
IS 3231	Electric relay for power system protection
IS 5578	Guide for making of insulated conductors
IS 8623	Low voltage switchgear and control gear assemblies
IS 13703	Low voltage fuses for voltages not exceeding 1000AC
IS 12063	Degree of enclosure protection
IS5	Color of mixed paints
IS 6297	Transformer & inductors for electronic equipment
IS 6553	Environment requirements for semiconductor device
IS 4007	Terminals for electronic equipment

**3 SERVICE CONDITIONS**

3.1	Max Ambient Temperature	50 deg C
3.2	Max Daily average ambient temp	40 deg C
3.3	Min Ambient Temp	0 deg C
3.4	Maximum Humidity	95%
3.5	Minimum Humidity	10%
3.6	Maximum annual rainfall	750 mm

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

3.7	Average no of rainy days per annum	60
3.8	Rainy months	June to Oct
3.9	Altitude above MSL	300 M
3.10	Seismic Zone	IV

**4 CHARGER DESIGN FEATURES**

4.1	Type	SMPS Based
4.2	Rating	For Type-1 Battery Charger a. 70 A for 50 V b. 35 A for 220 V For Type-2 Battery Charger a. 35 A for 50 V b. 20 A for 220 V
4.3	Configuration	2X100% Float cum Boost Charger.
4.4	Incoming Supply	Provision of Two Incoming Supply with Auto Changeover Facility
4.5	Automatic Phase Sequence Corrector	a. For 3 phase supply in right sequence, phase conversion. b. Protect equipment from phase reversal, phase loss.
4.6	Panel type	Metal enclosed frame construction
4.7	Overall Dimension	L - 1500 mm x D - 700 mm x H - 1900 mm
4.8	Cable Entry	Bottom
4.9	Location	Indoor, non air conditioned environment
4.10	Doors for front access	With anti theft hinge & handle
4.11	Cover for rear access	With Allen screw M6 size & handle
4.12	Construction	Sheet metal 2.0mm thick CRCA
4.13	Base frame	75mm ISMC
4.14	Lifting lugs	Four number
4.15	Gland plate	3mm metallic, un drilled & removable type
4.16	Enclosure protection	IP42 Minimum
4.17	Power terminal	Bus bar type, minimum 300mm above gland plate
4.18	Control terminal	Nylon66 with brass clamp
4.19	Bus bar	Tinned copper with insulation sleeve
4.20	Earth bus bar	Aluminum sized for rated fault duty for 1sec
4.21	Earth bus internal connection to all non current carrying metal parts	By copper flexible wire 2.5 sqmm
4.22	Earth bus external connection to owner earth	Al bus on both sides of panel with two holes for M10 bolt
4.23	Cooling	With Exhaust Fan
4.24	Panel heater	Thermostatically controlled through MCB
4.25	Panel internal wiring	Multi strand flexible color coded PVC insulated copper wire 1.5 sqmm 1100volt grade with 1.5 sqmm ferruling

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

		(other than circuit wiring related to PCB cards )
4.26	Isolation & protection device	Mounted at height minimum 1000mm from bottom
4.26.1	MCCB	For charger input, output & battery input
4.26.2	Battery & test resistor load	Lockable change over switch with one position for charger, second for 'OFF' & third position for external test resistor.
4.27	Hardware (Nut, bolts & handle)	Stainless steel
4.28	Essential provision	Surge suppression, harmonic suppression, blocking diodes, filters for ripple control
4.29	Insulating shrouds	On all live parts, power semi conductors & electronic components
4.30	Ripple content in DC output	0.5 % maximum
4.31	DC output voltage regulation	Maximum $\pm 1\%$ of rating with AC input supply variation of $\pm 10\%$ from 415 volts, frequency variation of $\pm 5\%$ from 50 HZ and simultaneous load variation of 0-100%
4.32	Reverse polarity connection	Protected against reversed battery polarity
4.33	Charger efficiency	90% minimum at Rated Load
4.34	Noise output	65DB maximum
4.35	Charger selector switch	For auto/manual and float/boost selection, lockable type inside panel
4.36	Charging current settings	25% to 100% of rating
4.37	Charging current accuracy	2% of set current with input voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$
4.38	Auto and Manual DC output adjustment range for float & boost charge (voltage & current)	By potentiometers inside panel, range suitable for battery bank. Charger suitable for other type of batteries if offered, shall be subject to buyer's approval.
4.39	Louvers	With stainless steel wire mesh
4.40	Gasket	Neoprene rubber
4.41	Panel illumination lamp with door switch	MCB controlled, with 5/15amp switch socket
4.42	Panel door keys	4 no. per panel, identical key for all panels
4.43	PCBs for electronic circuitry	With protective layer finish at back
4.44	PCB soldering	Preferably by wave soldering process
4.45	PCB/ electronic card mounting	With press fit type locking arrangement
4.46	Semiconductor component mounting	Shall not be on bakelite sheet

**5 METERING, ANNUNCIATION & INDICATION**

5.1	Ammeter (96x96mm)	Digital type, for AC input, DC output & battery current. Auxiliary supply for meters should be 48V to 230V AC/DC (Universal type)
5.2	Voltmeter (96x96mm)	Digital type, with selector switch for AC input, DC output & battery voltage. Auxiliary supply for meters should be 48V to 230V AC/DC (Universal type)

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

5.3	LED indication on panel front	
5.3.1	Status	
5.3.1.1	Input AC supply available on R,Y & B phase	Red/yellow/blue color LED
5.3.1.2	Float cum Boost charger AC MCCB 'ON'	Red color LED for each charger module
5.3.1.3	Charger output DC 'ON'	Red color LED for each charger module
5.3.1.4	Outgoing DCDB feeder ON	Red color LED for each other
5.3.2	Fault	
5.3.2.1	DC earth fault	Amber color LED
5.3.2.2	Battery MCCB OFF	Amber color LED
5.3.2.3	Charger output DC under/ over voltage	Amber color LED
5.3.2.4	AC mains undervoltage	Amber color LED
5.4	Annunciation	Hooter with isolating switch for fault annunciation.
5.5	Potential free contacts for remote indication to be wired upto terminal block	a. AC under voltage b. AC over voltage c. CH-A AC MCCB trip/OFF d. CH-B AC MCCB trip/OFF e. CH-A Rect/Cond. fuse fail f. CH-B Rect/Cond. fuse fail g. CH-A DC MCCB trip/OFF h. CH-B DC MCCB trip/OFF i. Battery MCCB trip/OFF j. CH-A DC under voltage k. CH-B DC under voltage l. CH-A DC over voltage m. CH-B DC over voltage n. Battery DC under voltage o. Battery DC over voltage p. DC Bus over voltage q. DC Earth fault r. Battery Charger in boost mode
5.6	Microprocessor based monitoring unit cum controller	Charger should have a microprocessor based controller
5.6.1	Analog signals to be monitored by controller	a. AC Input Voltage and current b. DC output voltage and current for Charger -1 and Charger -2 c. Battery voltage and current
5.6.2	Alarms/Faults signals to be monitored by controller	a. AC under voltage b. AC over voltage c. CH-A AC MCCB trip/OFF d. CH-B AC MCCB trip/OFF e. CH-A Rect/Cond. fuse fail f. CH-B Rect/Cond. fuse fail g. CH-A DC MCCB trip/OFF h. CH-B DC MCCB trip/OFF i. Battery MCCB trip/OFF

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

		<ul style="list-style-type: none"> <li>j. CH-A DC under voltage</li> <li>k. CH-B DC under voltage</li> <li>l. CH-A DC over voltage</li> <li>m. CH-B DC over voltage</li> <li>n. Battery DC under voltage</li> <li>o. Battery DC over voltage</li> <li>p. DC Bus over voltage</li> <li>q. DC Earth fault</li> <li>r. Battery Charger in boost mode</li> </ul>
5.6.3	SCADA Interfacing	Microprocessor controller should have RS485 port capable of transmitting all analog and alarm/fault signal to RTU on open MODBUS protocol. Any hardware/software required to achieve the said compatibility shall be in bidder's scope.
5.6.4	Display	Backlit display capable of displaying all the analog and fault/alarm signals mentioned above.

**6 APPROVED MAKE OF COMPONENTS**

6.1	Switch	Siemens / L&T (Salzer)
6.2	HRC Fuse Links	GE/ Siemens/ L&T
6.3	Diodes & SCR	Hirect/USHA/IOR
6.4	Meters	AE/Rishabh
6.5	AC Contractors &O/L Relay	L&T/Siemens/Telemecanique/GE/ABB
6.6	Terminals	Connectwell/Elmex/Wago/Phoenix
6.7	Push buttons / Actuator	L&T/Siemens/Vaishno
6.8	MCCB	L&T/Siemens/ ABB/GE
6.9	MCB	Datar/Legrand/Hager/Schneider
6.10	Indicating lamps LED type	Vaishno/Binay/Teknic/Siemens/Mimic

**7 MIMIC DIAGRAM, LABEL & FINISH**

7.1	Mimic diagram	To be provided
7.2	Name plate on panel front	
7.2.1	Material	Anodized aluminum 16SWG
7.2.2	Background	SATIN SILVER
7.2.3	Letter, diagram & boder	Black
7.2.4	Process	Etching
7.2.5	Name plate details	<ul style="list-style-type: none"> <li>a. Manufacturer name</li> <li>b. Month &amp; year of manufacture</li> <li>c. Equipment type</li> <li>d. Input &amp; Output rating</li> <li>e. Owner name &amp; order number</li> <li>f. Guarantee period</li> <li>g. Weight of panel</li> <li>h. Degree of protection</li> <li>i. Sr. No.</li> </ul>
7.3	Labels for meters, indication &	Anodized aluminum with white character on black

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

	all cards / sub assemblies in panel	background
7.4	Danger plate on front & rear side	Anodized aluminum with white letters on red background
7.5	Painting surface preparation	Shot blasting or chemical 7 tank process
7.6	Painting external finish	Powder coated polyester base grade A, shade –RAL 7032, uniform
7.7	Painting internal finish	Powder coated polyester base grade A, shade – white, uniform thickness 50 micron minimum
7.8	Labels for all components in panel	Anodized aluminum with white character on black background, fixed by rivets only
7.9	SLD	SLD of charges shall be provided at backside of the main door of Charger on Aluminium plate

**8 QUALITY ASSURANCE, INSPECTION & TESTING**

8.1	Vendor quality plan	To be submitted for purchaser approval
8.2	Inspection points	To be mutually identified & agreed in quality plan
8.3	Type test	Equipment should be of type tested quality only, type test certificate to be submitted along with offer. If the manufacturer's lab is accredited by govt. / authorized body then it shall be acceptable for type testing.
8.4	Routine test	As per relevant Indian standard
8.5	Acceptance test	To be performed in presence of Owner at manufacturer works <ul style="list-style-type: none"> <li>a. Physical inspection &amp; BOM, wiring check</li> <li>b. Insulation resistance test</li> <li>c. HV test for one minute</li> <li>d. Voltage regulation test</li> <li>e. Heat run test for 12 hours</li> <li>f. Measurement of efficiency, power factor &amp; ripple content</li> </ul>

**9 DEVIATIONS**

Deviation from this specification shall be stated in writing with the tender by reference to the specification clause/ GTP/ Drawing and description of alternative offer. In absence of such a statement, it shall be assumed by the buyer that the seller complies fully with this specification.

**10 GTP**

Vendor must submit clause wise compliance against specification at the time of drawing approval clearly highlighting the deviations from specification against each clause.



**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER****11 DRAWING AND DATA SUBMISSION MATRIX**

S. No	Head	Bid	Drawing Approval	Pre Dispatch	Pre Closure
11.1	Contact Person Name, Email ID and Mobile Number	Required	Required		
11.2	Deviation Sheet (as per "Deviations" Clause)	Required			
11.3	GTP		Required		
11.4	Relevant Type Test as per IS/IEC/UL	Required	Required		
11.5	Manufacturer's quality assurance plan and certification for quality standards		Required		
11.6	Sizing Calculation of Associated Equipment		Required		
11.7	Recommended Spares for five years of operation)		Required		
11.8	<b>Battery Charger Drawing</b>				
11.8.1	General Arrangement	Required	Required		
11.8.2	Sectional Layout		Required		
11.8.3	Cabinet Layout		Required		
11.8.4	SLD	Required	Required		
11.8.5	Schematic Circuit diagram and Scheme of Each type of Panel		Required		
11.8.6	Communication Architecture		Required		
11.8.7	QAP		Required		
11.8.8	BOQ		Required		
11.8.9	Plan		Required		
11.8.10	Foundation Diagram		Required		
11.8.11	Make of all Component as per specification		Required		
11.8.12	Drawing of Substation Room		Required		
11.9	Installation, erection and commissioning manual		Required		

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

S. No	Head	Bid	Drawing Approval	Pre Dispatch	Pre Closure
11.10	Inspection Reports			Required	
11.11	As manufacturing Drawings			Required	
11.12	Operation and Maintenance Manual			Required	
11.13	Trouble shooting manual			Required	
11.14	As built Drawings				Required

**12 PACKING**

12.1	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration. During transportation/ transit and storage, module may be subjected to outdoor conditions. Hence, packing of each panel shall be weatherproof.
12.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
12.3	Packing Identification Label to be provided on each packing case with the following details	
12.3.1	Individual serial number	
12.3.2	Purchaser's name	
12.3.3	PO number (along with SAP item code, if any) & date	
12.3.4	Equipment Tag no. (if any)	
12.3.5	Destination	
12.3.6	Project Details	
12.3.7	Manufacturer / Supplier's name	
12.3.8	Address of Manufacturer / Supplier / it's agent	
12.3.9	Description and Quantity	
12.3.10	Country of origin	
12.3.11	Month & year of Manufacturing	
12.3.12	Case measurements	
12.3.13	Gross and net weights in kilograms	
12.3.14	All necessary slinging and stacking instructions	
12.4	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration. During transportation/ transit and storage, module may be subjected to outdoor conditions. Hence, packing of each panel shall be weatherproof.
12.5	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
12.6	Packing Identification Label to be provided on each packing case with the following details	

**TECHNICAL SPECIFICATION FOR SMPS BASED BATTERY CHARGER**

12.6.1	Individual serial number
12.6.2	Purchaser's name
12.6.3	PO number (along with SAP item code, if any) & date
12.6.4	Equipment Tag no. (if any)
12.6.5	Destination
12.6.6	Project Details
12.6.7	Manufacturer / Supplier's name
12.6.8	Address of Manufacturer / Supplier / it's agent
12.6.9	Description and Quantity
12.6.10	Country of origin
12.6.11	Month & year of Manufacturing
12.6.12	Case measurements
12.6.13	Gross and net weights in kilograms
12.6.14	All necessary slinging and stacking instructions

**13 SHIPPING**

13.1	Shipping	The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, Overhead lines, free access etc. from the Manufacturing plant to the project site. Bidder shall furnish the confirmation that the proposed Packages can be safely transported, as normal or oversize packages, up to the site. Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.
		The seller shall be responsible for all transit damage due to improper packing.

**14 HANDLING AND STORAGE**

14.1	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.
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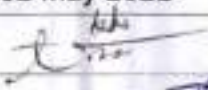
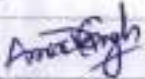
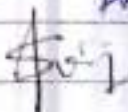
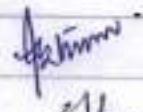
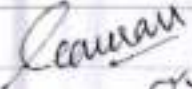

# BSES

## Technical Specification

Of

## Direct Current Distribution Board

Specification no – BSES-TS-71-DCDB-R0

Rev:		0
Pages:		1 of 16
Date:		02 May 2022
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**TECHNICAL SPECIFICATION FOR DCDB****1 SCOPE**

This specification covers the design, engineering, manufacture, assembly and testing at Manufacturer's works and supply of 220 VDC/50 VDC Distribution board (DCDB) along with all hardware and accessories required for installation and operation.

Specification covers Type 1 and Type 2 DCDB. Type 1 DCDB is for Grid Substations while Type 2 DCDB is for BSES HT Customers.

**2 STANDARDS AND CODES**

2.1	IS:8623	Specification for factory built assemblies of switchgear & control gear for voltages up to and including 1000V AC/1200 V DC.
2.2	IS 60947-1	Specification for Low-voltage Switchgear and Controlgear - Part 2 :Circuit Breakers
2.3	IS:10118	Code of practice for selection, installation and maintenance switchgear and control gear
2.4	IS:2705	Current transformers
2.5	IS:3231	Electrical relays for power system protection
2.6	IS:1248	Electrical Indicating instruments
2.7	IS:4794	Switches and push buttons
2.8	IS:6005	Code of practice of phosphating iron and steel
2.9	IS:5082	Wrought Aluminium and aluminum alloys for electrical purposes
2.10	IS 3043	Code of practice for Earthing

**3 SERVICE CONDITION**

3.1	Location	Indoor
3.2	Average grade atmosphere	Heavily polluted, Dry
3.3	Maximum altitude above sea level	1000M
3.4	Ambient air temperature	Highest 50Deg C Average 40Deg C
3.5	Minimum ambient air temperature	0 Deg C
3.6	Relative Humidity	100%

**TECHNICAL SPECIFICATION FOR DCDB**

3.7	Rainfall	750mm concentrated in four months
3.8	Seismic Zone	IV

**4 CONSTRUCTION**

4.1	General construction	It shall be free-standing type comprising dust-tight and vermin-proof sheet steel cabinets suitable for indoor installation with IP-54 degree of protection. Necessary busbar support insulators, cable glands, cable supports and terminal blocks etc. The board shall preferably be of single front type.
4.2	Material	The Board shall be made cold rolled steel sheet having Thickness of 2.5 mm of load bearing member and 2 mm for Doors and covers , suitably reinforced to provide flat level surfaces. No welds, rivets, hinges or bolts shall be visible from outside.
4.3	Equipment Mounting	All switches provided on the distribution board shall be on front side of the cabinets, operable from outside. All instruments and control devices shall be mounted on the front of cabinets and fully wired to the terminal blocks.
4.4	Busbar housing	The busbars shall be housed in totally enclosed busbar chambers. Incoming connections from the busbar to various feeders shall be designed so as not to disturb cable connections. Busbar arrangement should ensure safety of the operation/maintenance personnel and facilitate working on any outgoing module without the need for switching off in-feed to the adjacent modules, as far as possible
4.5	Cable alleys	A cable alley preferably 230 mm wide shall be provided in each vertical section for taking cables into the compartments. Cable alleys shall be provided on sides of busbar chamber.
4.6	Cable entry	Cable entry should be from bottom
4.7	Cable glands	Compression type cable glands shall be provided to hold the cables to avoid any pressure or tension on the terminal block connections.
4.8	Gland Plate	Gland plate shall be 3.0mm thick.
4.9	Doors	The doors of cabinets shall be lockable and shall be fitted with double lipped gaskets.
4.10	Gasket	All doors, removable covers and panels shall be gasketed all around with neoprene gaskets. Gaskets shall be embedded through machine only.
4.11	Ventilating louvers	Ventilating louvers shall have screens and filters. The screens shall be made of either brass or GI wires mesh.

**TECHNICAL SPECIFICATION FOR DCDB**

4.12	Foundation	The panels shall be fixed on the embedded foundation channels with intervening layers anti vibration strips made of shock absorbing materials.
4.13	Base Frame	Base frames shall be supplied along with panels. 100mm channel painted black.
4.14	Mounting	Equipment on front of panel shall be flush mounted. No equipment shall be mounted on the doors.
4.15	Working level	The center lines of switches, push buttons and indicating lamps shall not be less than 750mm and higher than 1600mm from panel base.
4.16	Dimension	500(L)X500(D)X1800(H) mm <sup>3</sup>

**5 CONFIGURATION**

5.1	Incomers	One incomers having Double Pole DC MCB with Aux Switch.			
5.2	Outgoing feeders	All outgoing feeders shall have MCB. Number of outgoing feeders shall be as per table attached			
Application	No of Poles	Type-1		Type-2	
		Rating of MCB (In Amp)	Quantity	Rating of MCB (In Amp)	Quantity
Incomer	2	100	1	50	1
Emergency Lighting DB	2	32	1	16	1
Fire Alarm System	2	32	1	16	0
SCADA	2	32	2	16	1
CRP/33 kV/66 kV Switchgear	2	32	4	16	1
11 kV Switchgear	2	32	4	16	0
Testing Purpose	2	32	1	16	1
NIFPS	2	32	4	16	0
Spare 1	2	100	1	50	1
Spare 2	2	32	4	16	2



**TECHNICAL SPECIFICATION FOR DCDB****6 BUSBARS**

6.1	Material	Busbar shall be of tinned electrolytic copper or Aluminium
6.2	Size	Suitable for carrying the rated continuous current of 100 A and short circuit current of 15 kA. Busbars shall be continuous throughout the panel. Temperature rise should be limited to 40 degrees over ambient.
6.3	Supports	The busbar shall be supported by means of durable non-hygroscopic, non-combustible and non-tracking polyester fiberglass material or porcelain. Supports shall be capable of withstanding the maximum short circuit stresses.
6.4	Sleeves and shrouds	Busbars shall be encased in heat-shrinkable sleeves of insulating material which shall be suitable for the operating temperature of busbars during normal service. The busbar joints shall be provided with removable thermosetting plastic shrouds.

**7 TERMINALS AND WIRING**

7.1	Wiring	
7.1.1	Grade and type	1100 V grade, PVC insulated, FRLS type stranded flexible copper wire.
7.1.2	Ferruling	Each wire shall bear an identifying ferrule or tag at each end or connecting point.
7.1.3	Spare	20% Spare Wiring
7.2	Terminals	Terminals of appropriate size shall be provided inside each cabinet for incoming and outgoing cables.
7.2.1	Grade	1100 V grade, moulded piece terminals complete with insulated barriers, washers, nuts and lock nuts.
7.2.2	Power Terminals type	Stud type, nut driver operated
7.2.3	Control terminals type	Stud type, screw driver operated
7.2.4	Spare terminals	20% spare terminals should be provided in each terminal block.
7.2.5	Accessibility	Placement of terminals shall enable proper cable termination. Terminals shall be readily accessible for inspection and maintenance.
7.2.6	Marking	The terminals shall be serially numbered to facilitate installation and maintenance.

**TECHNICAL SPECIFICATION FOR DCDB****8 METERS, INDICATIONS, PUSH BUTTONS & HEATERS**

8.1	Meters	
8.1.1	Ammeter	DC Moving coil ammeter of size 96 sq.mm. with external shunt. Rating of Ammeter shall be 0-100A DC.
8.1.2	Voltmeter	DC Moving coil voltmeter of size 96.sq.mm to read the DC Bus voltage. Rating of Voltmeter shall be 0-300VDC
8.1.3	Type	Digital type, connected through instruments transformers of suitable rating.
8.2	Indicating lamps	Indicating lamps shall be of low wattage cluster LED type.
8.2.1	Incomer/ Outgoing On	Red
8.2.2	Incomer/ Outgoing Off	Green
8.2.3	Incomer/ Outgoing Trip	Amber
8.3	Push buttons	For manual operation of incomer MCB
8.4	Heaters	Cubicle space heater having rating of 100W. Thermostat for space heater shall be provided with temperature range 0-90 <sup>0</sup>
8.5	CFL	Cubicle lamp shall be provided in DCDB having rating of 11 W.

**9 NAME PLATES & MARKINGS**

9.1	Panel nameplate	Panel shall have a nameplate clearly indicating the following: a. Panel Serial No.- b. Customer Name - BSES Yamuna/Rajdhani Power Ltd c. PO No. & date - d. Type of Panel - e. Current rating - f. Guarantee period -
9.2	Feeder nameplate	Large and bold name plate carrying the feeder identification shall be provided on the top.
9.3	Equipment nameplate	a. All equipment mounted on front side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. b. All front mounted equipment shall be also provided

**TECHNICAL SPECIFICATION FOR DCDB**

		at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.
9.4	Material	Non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering. Stickers are not allowed.
9.5	Fixing	All nameplates/rating plates shall be riveted to the panels at all four corners. Bolting/screwing is not acceptable.
9.6	Markings	Each switch shall bear clear inscription identifying its function. Similar inscription shall also be provided on each device whose function is not otherwise identified. If any switch or device does not bear this inscription separate nameplate giving its function shall be provided for it. Switch shall also have clear inscription for each position indicating e.g. Trip-Neutral close, ON-OFF etc.

**10 FINISH**

10.1	Primer	Two coats
10.2	Paint	Two finishing coats of epoxy based paint of Shade RAL 7032 with glossy finish.
10.3	Paint thickness	50 microns (minimum)

**11 APPROVED MAKES OF COMPONENTS**

11.1	Switch	Siemens / L&T (Salzer)
11.2	HRC Fuse Links	GE/ Siemens/ L&T
11.3	Meters	Rishabh/Schneider/AE
11.4	Terminals	Connectwell/Elmex/Wago/Phoenix
11.5	Push buttons / Actuator	L&T/Siemens/Vaishno/Schneider
11.6	MCB	Datar/Legrand/Hager/Schneider/ABB
11.7	Indicating lamps	Vaishno/Binay/Teknic/Siemens/Mimic/C&S

**TECHNICAL SPECIFICATION FOR DCDB****12 INSPECTION AND TESTING**

12.1	Type test	Equipment should be of type tested quality only, type test certificate to be submitted along with offer. If the manufacturer's lab is accredited by govt. / authorized body then it shall be acceptable for type testing.
12.2	Acceptance & Routine tests	As per relevant Indian standard

**13 PACKING, SHIPPING, HANDLING AND SITE SUPPORT**

13.1	Packing Protection	The packing shall be fit to withstand rough handling during transit and storage at destination. The test set should be properly protected against corrosion, dampness & damage.
13.2	Packing for accessories and spares	Robust non-returnable packing case with all the above protection & identification Label. The bidder should get the packing list approved before dispatching the material.
13.3	Packing Identification Label	On each packing case, following details are required:
13.3.1	Individual serial number	
13.3.2	Purchaser's name	
13.3.3	PO number (along with SAP item code, if any) & date	
13.3.4	Equipment Tag no. (if any)	
13.3.5	Destination	
13.3.6	Manufacturer / Supplier's name	
13.3.7	Address of Manufacturer / Supplier / it's agent	
13.3.8	Description	
13.3.9	Country of origin	
13.3.10	Month & year of Manufacturing	
13.3.11	Case measurements	

**TECHNICAL SPECIFICATION FOR DCDB**

13.3.12	Gross and net weight	
13.3.13	All necessary slinging and stacking instructions	
13.4	Shipping	The seller shall be responsible for all transit damage due to improper packing.
13.5	Handling and Storage	Manufacturer instruction shall be followed.
13.6	Detail handling & storage instruction sheet / manual to be furnished before commencement of supply.	

**14 DEVIATIONS**

14.1	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.
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**15 DOCUMENT SUBMISSION**

Drawing submission shall be as per the matrix given below. All documents/ drawing shall be provided on A3/A4 sheet in box file with separators for each section. Also provide USB containing pdf with bid for soft copy. Language of the documents shall be English only. Deficient/ improper document/ drawing submission may liable for rejection

S. No	Head	Bid	Drawing Approval	Pre Dispatch	Pre Closure
15.1	Contact Person Name, Email ID and Mobile Number	Required			
15.2	Deviation Sheet	Required	Required		
15.3	Type Test	Required			
15.4	Any Technological Advancement in DCDB	Required			
15.5	Manufacturer's quality assurance plan and certification for quality standards				
15.6	General Arrangement		Required		
15.7	Door Layout		Required		

**TECHNICAL SPECIFICATION FOR DCDB**

15.8	Internal Layout		Required		
15.9	SLD		Required		
15.10	Schematic Circuit diagram		Required		
15.11	Bus Bar Arrangement		Required		
15.12	Cable Alley Arrangement		Required		
15.13	GTP	Required	Required		
15.14	QAP		Required		
15.15	BOQ		Required		
15.16	Foundation diagram		Required		
15.17	TB Detail		Required		
15.18	Name Plate Detail		Required		
15.19	Make of all Component as per specification		Required		
15.20	Inspection Report			Required	
15.21	As manufacturing Drawings			Required	
15.22	Operation and Maintenance Manual			Required	Required
15.23	Trouble shooting manual			Required	Required
15.24	As built Drawings				Required
15.25	Test Report				Required

**16 GUARANTEED TECHNICAL PARTICULARS**

Vendor must submit clause wise compliance in Excel sheet against specification at the time of drawing approval clearly highlighting the deviations from specification against each clause.

<b>S. No.</b>	<b>Description</b>	<b>Specification requirement</b>	<b>Bidder's Data</b>
16.1	<b>GENERAL FEATURES</b>		
16.1.1	Make		
16.1.2	Type		
16.1.3	Reference Standard		

**TECHNICAL SPECIFICATION FOR DCDB**

16.1.4	Rated Operational voltage	220 VDC/50 VDC	
16.1.5	Rated Nominal Current	100	
16.1.6	Rated Insulation voltage	1100V	
16.1.7	Rated Impulse withstand voltage	8kV	
16.1.8	Service supply for heating, lighting and power sockets	240VAC±10%	
16.1.9	Mounting	Floor (Free standing)	
16.1.10	Connections	Cable entry – Bottom	
16.1.11	Configuration	Single front	
16.1.12	Enclosure thickness		
a	Load Bearing Member	≥2.5mm	
b	Doors and Covers	≥2 mm	
c	Gland Plate	3 mm	
16.1.13	Enclosure Material	CRCA Sheet	
16.1.14	Enclosure degree of protection	IP 54	
16.1.15	Power Cable Termination	Suitable for 4CX50 Sq.mm Al	
16.1.16	Paint shade	RAL 7032 (Siemens Grey)	
16.1.17	Typical vertical section (Overall dimension (mm) and weight ( Kg))		
16.1.18	Incomer	Required	
16.1.19	Outgoings		
16.1.20	Dimensions of the DCDB Panel	500(L)X500(D)X1800(H) mm <sup>3</sup>	
16.1.21	Weights of the DCDB Panel	(in kg.)	
16.1.22	Marking on the panel	As per the specification	
16.1.23	Cable Alley Width	230 mm	
16.1.24	Cable Gland	Compression Type	

**TECHNICAL SPECIFICATION FOR DCDB**

16.1.25	Gasket Material	Neoprene	
16.1.26	Ventilating louvers	Required	
16.1.27	Base Frame	100mm channel	
16.2	<b>MCB</b>		
16.2.1	Make	<b>Datar/Legrand/Hager/Schneider/ABB</b>	
16.2.2	Incomer	100A/50 A	
16.2.3	Emergency Lighting DB	32A/16 A	
16.2.4	Fire Alarm System	32A/16 A	
16.2.5	SCADA	32A/16 A	
16.2.6	CRP	32A/16 A	
16.2.7	11 kV Switchgear	32A/16 A	
16.2.8	Testing Purpose	32A/16 A	
16.2.9	NIFPS	32A/16 A	
16.2.10	Spare 1	100A/50 A	
16.2.11	Spare 2	32A/16 A	
16.3	<b>BUS AND BUS TAPS</b>		
16.3.1	Make		
16.3.2	Material	Tinned electrolytic copper or Aluminum	
16.3.3	Reference standard		
16.3.4	Continuous Current (at site condition, 50°C ambient) within cubicle		
16.3.5	Short Circuit withstand Current for 1 sec	15 KA	
16.3.6	Cross sectional Area		
16.3.7	DC resistance	ohm/m/ph	



**TECHNICAL SPECIFICATION FOR DCDB**

16.3.8	Reactance	ohm/m/ph	
16.3.9	Losses-middle phase	w/m/ph	
16.3.10	Minimum clearance of bus bar and joints	Required	
16.3.11	Phase to phase (mm)		
16.3.12	Phase to earth (mm)		
16.3.13	Bus bar insulation	i. Heat shrinkable sleeves rated for maximum operating voltage	
		ii. Cast resin shrouds for joint	
16.3.14	Bus joints	Silver	
16.3.15	Bus bar support insulator	Required	
16.3.16	Spacing (mm)		
16.3.17	Make		
16.3.18	Type		
16.3.19	Reference standard		
16.3.20	Voltage class (kV)		
16.3.21	Minimum creepage distance (mm)		
16.3.22	Cantilever strength (Kg/sq.cm.)		
16.4	<b>Wiring and Terminals</b>		
16.4.1	<b>Wiring</b>		
a	Grade and type	1100 V grade, PVC insulated, FRLS type stranded flexible copper wire.	
b	Ferruling	Each wire shall bear an identifying ferrule or tag at each end or connecting point.	
c	Spare	20% Spare Wiring	
16.4.2	<b>Terminals</b>		
a	Grade	1100 V grade, moulded piece terminals complete with insulated barriers, washers, nuts and lock nuts.	
b	Power Terminals type	Stud type, nut driver operated	
c	Control terminals type	Stud type, screw driver operated	

**TECHNICAL SPECIFICATION FOR DCDB**

d	Spare terminals	20% spare	
e	Accessibility	Placement of terminals shall enable proper cable termination. Terminals shall be readily accessible for inspection and maintenance.	
f	Marking	The terminals shall be serially numbered to facilitate installation and maintenance.	
16.5	<b>METERS, INDICATIONS, PUSH BUTTONS &amp; HEATERS</b>		
16.5.1	Ammeter	DC Moving coil ammeter of size 96 sq.mm. with external shunt. Rating of Ammeter shall be 0-100A DC.	
a	Model No Ammeter		
b	Make of Ammeter		
16.5.2	Voltmeter	DC Moving coil voltmeter of size 96.sq.mm to read the DC Bus voltage. Rating of Voltmeter shall be 0-300VDC	
a	Model No Voltmeter		
b	Make of Voltmeter	Rishabh/Schneider/AE	
c	Type	Digital type	
16.5.3	Indicating lamps	Cluster LED type.	
a	Make of Indicating lamps	Vaishno/Binay/Teknic/Siemens/Mimic/C &S	
b	Incomer/ Outgoing On	Red	
c	Incomer/ Outgoing Off	Green	
d	Incomer/ Outgoing Trip	Amber	
e	Push buttons Make	L&T/Siemens/Vaishno/Schneider	
16.5.4	Heaters	Cubicle space heater having rating of 100W. Thermostat for space heater shall be provided with temperature range 0-90 <sup>0</sup>	
16.5.5	CFL	Cubicle lamp shall be provided in DCDB having rating of 11 W.	

**TECHNICAL SPECIFICATION FOR DCDB**

16.6	<b>NAME PLATES &amp; MARKINGS</b>		
a	Panel nameplate	Panel Serial No.-	
b		Customer Name - BSES Yamuna/Rajdhani Power Ltd	
c		PO No. & date -	
d		Type of Panel -	
e		Current rating -	
f		Guarantee period -	
16.6.1	Feeder nameplate	As per Spec	
a	Equipment nameplate	As per Spec	
b	Material	As per Spec	
c	Fixing	As per Spec	
d	Markings	As per Spec	
16.7	<b>FINISH</b>		
a	Primer	Two coats	
b	Paint	Two finishing coats of epoxy based paint of Shade RAL 7032 with glossy finish.	
c	Paint thickness	50 microns (minimum)	

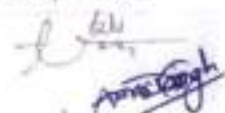

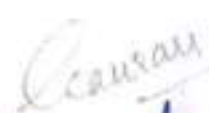
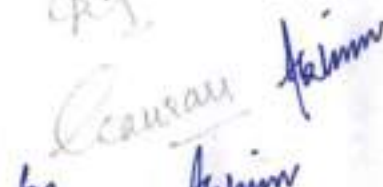
# BSES

## Technical Specification

Of

50 V and 220 V Lithium Ion Battery Bank

Specification no – BSES-TS-72-LiBB-R0

Rev:		0
Pages:		1 of 14
Date:		29 Apr 2022
Prepared by	Abhishek Harsh Amar Singh Srinivas Gopu	 
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## 1 SCOPE

This specification covers the design, manufacture, testing, supply, erection & commissioning of 50 V & 220 V Li Ion Battery Bank.

Specification covers Type 1 and Type 2 Li Ion Battery Bank. Type 1 Battery Bank is for Grid Substations while Type 2 Battery Bank is for BSES HT Customers.

## 2 CODES & STANDARDS

Material, equipment and methods used in the manufacturing of Li Ion battery shall confirm to the latest edition of following standard

S. No	Standard Name / No	Standard's Description
2.1	Indian Electricity Act	Latest Edition
2.2	CBIP manual	Latest Edition
2.3	IEC 62281,62619, 61000-4-2	Safety of primary and secondary lithium cells and batteries, Safety requirements for secondary lithium cells and batteries, for use in industrial applications, Electrostatic Discharge Immunity Test
2.4	IEC 62133, IEC 62620:2014,	Battery Safety
2.5	IEC 61960	Performance tests, Designations, markings, dimensions, and other requirements
2.6	IEC 61959	Tests and requirements for verifying the mechanical behavior.
2.7	IS 5	Paint and Enamels
2.8	IS 13703	LV Fuses
2.9	IS 5578	Guide for marking insulated conductors
2.10	IS 694	Polyvinyl Chloride Insulated Unsheathed And Sheathed Cables/Cords With Rigid And Flexible Conductor For Rated Voltages Up To And Including 450/750 V
2.11	IS 1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
2.12	IEEE	Relevant Standard
2.13	UL 1642	Individual cell compliance
2.14	UL 1973	Battery module complies, test methods and requirements to ensure safety during transport other than for recycling or disposal
2.15	UL 2054	Household and commercial Batteries

### 3 SERVICE CONDITIONS

3.1	Max Ambient Temperature	50 deg C
3.2	Max Daily average ambient temp	40 deg C
3.3	Min Ambient Temp	0 deg C
3.4	Maximum Humidity	95%
3.5	Minimum Humidity	10%
3.6	Maximum annual rainfall	750 mm
3.7	Average no of rainy days per annum	60
3.8	Rainy months	June to Oct
3.9	Altitude above MSL	300 M
3.10	Seismic Zone	IV

### 4 DC DISTRIBUTION SYSTEM DATA

4.1	DC Supply	2 wire, with positive & negative polarity
4.2	Earth reference	Unearthed system
4.3	Voltage	50 VDC/ 220 VDC
4.4	Application	Standby DC back up for switchgear control supply & SCADA RTU

### 5 GENERAL FEATURES

5.1	Number of Modules	6 (Maximum)
5.2	Connection of Modules	Parallel
5.3	DC battery bank Ah rating	For Type-1 Li Ion Battery Bank a. 600 Ah for 50 V b. 300 Ah for 220 V For Type-2 Li Ion Battery Bank a. 200 Ah for 50 V b. 100 Ah for 220 V
5.4	Voltage Output	50 V / 220 V
5.5	Battery Efficiency	>90%
5.6	Gas Evolution from Battery	None
5.7	DC load curve	With High discharge characteristics.
5.8	Location of Module	Indoor
5.9	Ingress Protection	IP 4X
5.10	Installation	On cabinet, painted with anti-corrosive paint.

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

5.11	Battery type	Li Ion Battery
5.12	Cell Chemistry	Different chemistry with material Manganese /Cobalt/iron/titanium etc subject to fulfillment of required parameters as mentioned in this specification.
5.13	Battery lifting/withdrawing arrangement	Suitable arrangement on Module
5.14	Battery Module marking	PO Number and Date, Customer Name- BSES Yamuna/Rajdhani Power Limited, Manufacturer name, month & year of manufacturer, Warranty Period, Nominal voltage, rated Ah capacity & cell number , Customer Care Number
5.15	Terminal polarity marking	Positive& negative marked on Module
5.16	Battery cell shorting metal links	Nickel plated copper with protective insulating sleeve
5.17	Insulating shrouds	For all battery terminals & shorting links
5.18	Insulating pads for battery rack	At the bottom of rack supports, made from high impact material
5.19	Battery suitable for Ripple content	5% minimum in DC charger output

**6 BATTERY MANAGEMENT SYSTEM**

Module must comprise BMS (Battery Management System) which monitors battery internal vital parameters, measures and displays various alarms/warnings; establish a communication link with the external system i.e. Charger, SCADA.

6.1	Arrangement	<ul style="list-style-type: none"> <li>a. Battery shall comprise of two strings of equal rating.</li> <li>b. In Type-1 Battery Bank, for 220 VDC, two strings of 150 Ah capacity shall be provided</li> <li>c. In Type-1 Battery Bank, for 50 VDC, two strings of 300 Ah capacity shall be provided</li> <li>d. In Type-2 Battery Bank, for 220 VDC, two strings of 50 Ah capacity shall be provided</li> <li>e. In Type-2 Battery Bank, for 50 VDC, two strings of 100 Ah capacity shall be provided</li> <li>f. Each battery string should have its own dedicated BMS.</li> <li>g. Refer Annexure –A for architecture</li> </ul>
6.2	Display	BMS shall have a display showing all measured parameters.
6.3	Communication	
6.3.1	Protocol For SCADA Interface	Modbus
6.3.2	Port	RS-485



**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

6.3.3	Key Battery Parameters to be Integrated With SCADA	As per Annexure-A
6.3.4	Status LED	Dual color type
6.3.5	SOC LED	Dual color type
6.3.6	In-built data logging	Upto 6 months
6.3.7	Protection feedback to SCADA	From S.No 7.4.7 to 7.4.13
6.4	Safety Feature	
6.4.1	Module reverse polarity protection	
6.4.2	Internal fuse	
6.4.3	Controllable internal fuse	
6.4.4	Protective terminal covering to avoid unintentional contact	
6.4.5	Secondary level hardware protection for overvoltage	
6.4.6	Heat propagation resistant cell holding structure	
6.4.7	Overvoltage protection	
6.4.8	Under voltage protection	
6.4.9	Over charging current protection	
6.4.10	Over discharge current protection	
6.4.11	Over temperature during discharge protection	
6.4.12	Over temp during charge protection	
6.4.13	Over internal FET temp protection	
6.5	Arrangement for Bypassing the BMS	

**7 CABINET**

7.1	Panel Type	a. Separate compartment shall be provided for both battery strings b. Simplex panel with Dimension 0.6x0.6x1.4 m <sup>3</sup>
7.2	Pocket	Pocket for Drawing is required
7.3	Display	a. Local LED Display on Cabinet shall be provided having key battery Parameters. b. Battery key parameters shall be as per Annexure-A
7.4	Ingress Protection	IP4Xin accordance with IS 13947
7.5	Cooling	Natural
7.6	Enclosure material	Pre-galvanized, cold-rolled sheet steel of thickness not less than 2.0 mm. Stiffeners shall be provided wherever necessary.
7.7	Doors	Double leaf doors shall be provided at the rear. Doors shall have handles with built-in locking facility
7.8	Gland Plate	At least two separate gland plates of removable type with gasket shall be provided for each panel. They shall be of sheet steel of thickness not less than 3.0 mm.

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

7.9	Gaskets	All doors, removable covers and panels shall be Gasketed all around with neoprene gaskets
7.10	Foundation	The panels shall be fixed on the embedded foundation channels with intervening layers anti vibration strips made of shock absorbing materials
7.11	Base Frame	Base frames shall be supplied along with panels.
7.12	Earthing	50x6 sqmm GI Earth bus shall run through the cabinet and same shall be extended to outside of the panel from both sides for earthing purpose.
7.13	Pocket	Pocket shall be Provided for drawing placement purpose

**8 NAMEPLATES AND MARKING**

8.1	Panel nameplate	<ul style="list-style-type: none"> <li>a. BSES Logo</li> <li>b. Property of BSES</li> <li>c. Name of manufacturer</li> <li>d. Name of customer</li> <li>e. Battery Rating</li> <li>f. PO no. &amp; Date</li> <li>g. Serial Number</li> <li>h. Month &amp; year of manufacturing</li> <li>i. Guarantee period</li> <li>j. Manufacturer Call center no. &amp; email id</li> <li>k. Weight of Panel</li> </ul>
8.2	Name Plate Material	Anodized Aluminum 16SWG
8.3	Background	Satin Silver
8.4	Letter, Diagram & Border	Black
8.5	Process	Etching
8.6	Equipment ID Marking	<p>Shall be given at the time of drawing approval. Following will be the features:</p> <ul style="list-style-type: none"> <li>a. Equipment ID shall be painted on any appropriate face of the equipment at a clearly readable height from the base level of the equipment.</li> </ul>

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

		<ul style="list-style-type: none"> <li>b. Font: Recommended type face for the signage is True type or Post script.</li> <li>c. Font Size: All painting should be in UPPERCASE. Recommended height of 50 mm with spacing between alphabets of 3 mm.</li> <li>d. Total No's of Character: 18</li> <li>e. Height of Font: 50 mm</li> <li>f. Height of Base: 100 mm</li> <li>g. Spacing between alphabets: : 3 mm</li> <li>h. Paint: Base coat – Dense Yellow. Letters – Black Quick Drying paint 2 coats.</li> </ul>
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**9 EQUIPMENT LIST**

9.1	Battery Cabinet
9.2	Battery Module
9.3	Communication cable
9.4	DC power cable
9.5	Cable terminal block/bus-bar
9.6	Earth cable
9.7	Tools and Accessories for Maintenance
9.8	Mandatory and Recommended Spares if Any

**10 INSPECTION & TESTING**

10.1	Type test	Equipment shall be type tested from CPRI/ERDA accredited lab as per IEC/IS/UL standard.
10.2	Routine test	As per relevant standard
10.3	Acceptance test	To be performed in presence of Owner at manufacturer works shall be as per approved QAP
10.4	Heating Compliance	JIS C8712
10.5	ROHS Compliance	Required

**11 GTP**

Vendor must submit clause wise compliance in Excel sheet against specification at the time of drawing approval clearly highlighting the deviations from specification against each clause.

**12 DEVIATIONS**

Deviation from this specification shall be provided in excel sheet with the tender by reference to the specification clause/ GTP/ Drawing and description of alternative offer. In

absence of such a statement, it shall be assumed by the buyer that the seller complies fully with this specification.

### 13 DRAWING AND DATA SUBMISSION MATRIX

Document submission shall be as per the matrix given below. All documents/drawing shall be provided in soft copy (in pen drive) for each section. Language of the documents shall be English only. Deficient/improper drawing submission may liable for rejection.

S. No	Head	Bid	Drawing Approval	Pre Dispatch	Pre Closure
13.1	Contact Person Name, Email ID and Mobile Number	Required	Required		
13.2	Deviation Sheet(as per "Deviations" Clause)	Required			
13.3	GTP		Required		
13.4	Relevant Type Test as per IS/IEC/UL	Required	Required		
13.5	Manufacturer's quality assurance plan and certification for quality standards		Required		
13.6	Sizing Calculation of Associated Equipment		Required		
13.7	Recommended Spares for five years of operation)		Required		
13.8	<b>Li Ion drawing</b>				
13.8.1	General Arrangement	Required	Required		
13.8.2	Sectional Layout		Required		
13.8.3	Cabinet Layout		Required		
13.8.4	Battery Layout		Required		
13.8.5	SLD	Required	Required		
13.8.6	Schematic Circuit diagram and Scheme of Each type of Panel		Required		
13.8.7	Communication Architecture		Required		

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

13.8.8	QAP		Required		
13.8.9	BOQ		Required		
13.8.10	Plan		Required		
13.8.11	Foundation Diagram		Required		
13.8.12	Make of all Component as per specification		Required		
13.8.13	Drawing of Substation Room		Required		
13.9	Installation, erection and commissioning manual		Required		
13.10	Inspection Reports			Required	
13.11	As manufacturing Drawings			Required	
13.12	Operation and Maintenance Manual			Required	
13.13	Trouble shooting manual			Required	
13.14	As built Drawings				Required

**14 PACKING**

14.1	Packing Protection	Against corrosion, dampness, heavy rains, breakage and vibration. During transportation/ transit and storage, module may be subjected to outdoor conditions. Hence, packing of each panel shall be weatherproof.
14.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection & identification Label
14.3	Packing Identification Label to be provided on each packing case with the following details	
14.3.1	Individual serial number	
14.3.2	Purchaser's name	
14.3.3	PO number (along with SAP item code, if any) & date	
14.3.4	Equipment Tag no. (if any)	
14.3.5	Destination	



**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

14.3.6	Project Details
14.3.7	Manufacturer / Supplier's name
14.3.8	Address of Manufacturer / Supplier / it's agent
14.3.9	Description and Quantity
14.3.10	Country of origin
14.3.11	Month & year of Manufacturing
14.3.12	Case measurements
14.3.13	Gross and net weights in kilograms
14.3.14	All necessary slinging and stacking instructions

**15 SHIPPING**

15.1	Shipping	<p>The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, Overhead lines, free access etc. from the Manufacturing plant to the project site. Bidder shall furnish the confirmation that the proposed Packages can be safely transported, as normal or oversize packages, up to the site. Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.</p>
		<p>The seller shall be responsible for all transit damage due to improper packing.</p>

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK****16 HANDLING AND STORAGE**

16.1	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.
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**17 QUALITY AND ASSURANCE**

17.1	Vendor quality plan	To be submitted for purchaser approval
17.2	Inspection points	To be mutually identified & agreed in quality plan

**18 ANNEXURE A- BATTERY KEY PARAMETERS**

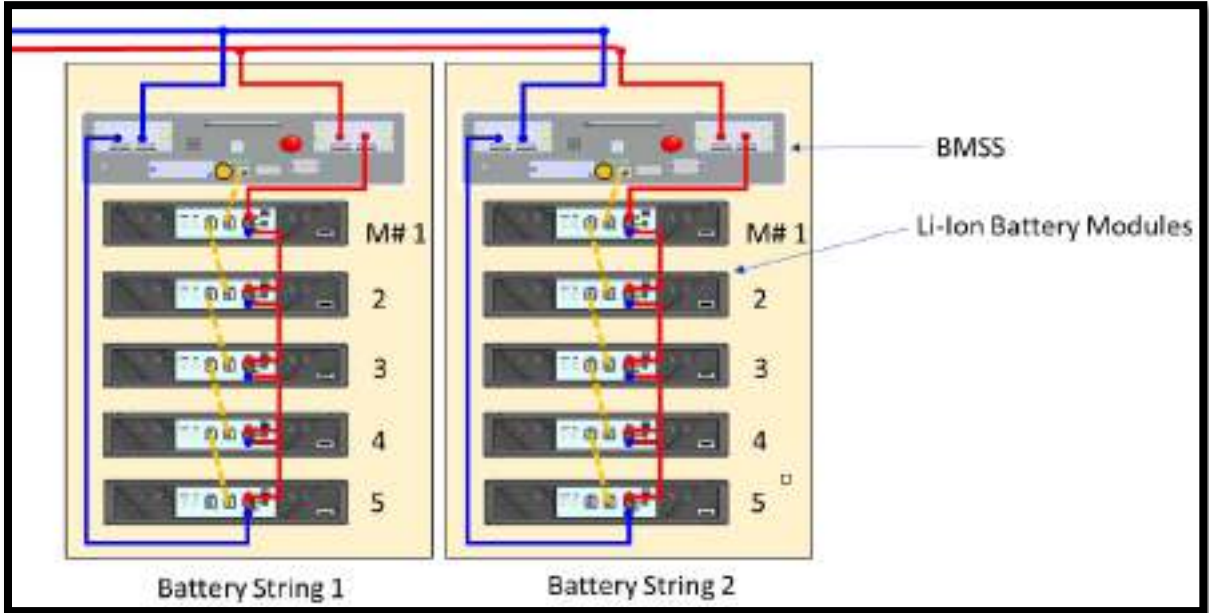
S.NO.	Description	BSES Requirement		Data to be filled by Manufacturer	
		50V	220V	50V	220V
18.1	Battery ( as per scope of supply) – Yes / No	Yes	Yes		
18.2	Battery type	Li-Ion	Li-ion		
18.3	Type/Model No.				
18.4	Cell Chemistry				
18.5	Battery nominal voltage with variation upto $\pm 5\%$				
18.6	Total battery bank CC-CV charging required in volts				
18.7	Nominal Voltage of each Cell				
18.8	No of cells in each module				
18.9	No. of modules				
18.10	Input charge voltage				
18.11	Charge current				
18.12	Discharge current				
18.13	Battery DOD	80% (minimum)	80% (minimum)		
18.14	Life cycle with 80% DOD	3000 (minimum)	3000 (minimum)		
18.15	Battery efficiency (watt hour round trip)	>92%	>92%		
18.16	Service life	10 Years	10 Years		

**TECHNICAL SPECIFICATION FOR Li ION BATTERY BANK**

18.17	Self-discharge rate per month	3% @ 25°C	3% @ 25°C		
18.18	Cut off voltage	45V	210V		
18.19	Submitted of deviation sheet for each specification clause no - Yes / No	Furnish each deviation if yes	Furnish each deviation if yes		
18.20	Battery rating offered in AH	600 AH/200 AH	300 AH/100 AH		
18.21	Rating at temperature 45 deg C	600 AH/200 AH	300 AH/100 AH		
18.22	Battery bank dimensions in mm ( length x depth x height)	As required	As required		
18.23	Battery Module weight in kg	As required	As required		
18.24	Heat generated by battery at rated full load (in Kw)	Less than 0.025kW/module	Less than 0.025kW/module		
18.25	Manufacturer of Li-Ion Battery Cells and Modules	Yes	Yes		
18.26	Manufacturer of Battery management system (BMS)	Yes	Yes		
18.27	Availability of Service team in India	Yes	Yes		
18.28	Built In Battery Management System	Yes	Yes		



#### 19 ANNEXURE B-BATTERY ARRANGEMENT



Battery System

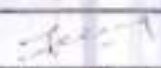



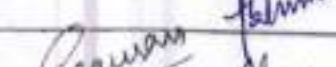


# BSES

## Technical Specification

For

415 V AC Distribution Board

Specification no – BSES-TS-70-ACDB-R0

Rev	0	
Page	1 of 17	
Date	05 May 2022	
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**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD****1 SCOPE**

This specification covers the design, engineering, manufacture, assembly and testing at manufacturer's works and supply of 415V AC Distribution board (ACDB) along with all hardware and accessories required for installation and operation.

Specification covers Type 1 and Type 2 ACDB. Type 1 ACDB is for Grid Substations while Type 2 ACDB is for BSES HT Customers.

**2 STANDARDS & CODES**

2.1	IS:8623	Specification for factory built assemblies of switchgear & control gear for voltages up to and including 1000V AC/1200 V DC.
2.2	IS 60947-1	Specification for Low-voltage Switchgear and Control gear - Part 2 : Circuit Breakers
2.3	IS:10118	Code of practice for selection, installation and maintenance switchgear and controlgear
2.4	IS:2705	Current Transformers
2.5	IS:3231	Electrical relays for power system protection
2.6	IS:1248	Electrical Indicating instruments
2.7	IS:4794	Switches and push buttons
2.8	IS:6005	Code of practice of phosphating iron and steel
2.9	IS:5082	Wrought Aluminum and aluminum alloys for electrical purposes
2.10	IS 3043	Code of practice for Earthing

**3 SERVICE CONDITIONS**

3.1	System Configuration	3 Phase 4 Wire with neutral solidly grounded
3.2	Supply Voltage	415 volt +/- 10%
3.3	Supply frequency	50Hz
3.4	Location	Indoor
3.5	Average grade atmosphere	Heavily polluted, Dry
3.6	Maximum altitude above sea level	1000M
3.7	Ambient air temperature	Highest 50Deg C Average 40Deg C
3.8	Minimum ambient air temperature	0 Deg C
3.9	Relative Humidity	100%
3.10	Rainfall	750mm concentrated in four months

**4 ACB CONFIGURATION****4.1 TYPE 1 ACDB CONFIGURATION**

4.1.1	Incomers	<p>a. Two incomers, each having Motorized 630A MCCB. MCCBs shall have microprocessor based over current and earth fault release.</p> <p>b. Auto changeover shall be provided between the two incomers</p> <p>c. Manual castle keyinterlock required between two incomers</p> <p>d. Castle key for Local /Remote operation</p>			
4.1.2	Outgoing feeders	<p>a. The number of outgoing feeders from AC boards shall be such that each substation equipment is fed by separate feeder (refer below).</p> <p>b. Utilization category of MCBs shall be C.</p>			
	<b>Application</b>	<b>Type of Switchgear</b>	<b>No of Poles</b>	<b>Rating (A)</b>	<b>Quantity</b>
4.1.3	Transformer Oil filtration	MCB	4	200	2
4.1.4	Welding(Outdoor)	MCB	2	63	4
4.1.5	Power Socket(Indoor)	MCB	4	32	5
4.1.6	Outdoor Lighting	MCB	4	32	2
4.1.7	Indoor Lighting	MCB	4	32	2
4.1.8	Battery Charger	MCB	4	63	2
4.1.9	BMK	MCB	4	32	8
4.1.10	Marshalling Box(PTR)	MCB	4	32	3
4.1.11	AC Supply	MCB	4	32	2
4.1.12	UPS	MCB	2	16	1
4.1.13	11kV Switchgear	MCB	2	32	3
4.1.14	CRP	MCB	2	32	2
4.1.15	RTU/SCADA	MCB	2	16	2
4.1.16	Fire Fighting	MCB	2	16	2
4.1.17	EPAX	MCB	2	16	1

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

4.1.18	Power (Outdoor)	Socket	MCB	2	16	4
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**4.2 TYPE 2 ACDB CONFIGURATION**

4.2.1	Incomers	<ul style="list-style-type: none"> <li>a. Two incomers, each having Motorized 400 A MCCB.</li> <li>b. Auto changeover shall be provided between the two incomers</li> <li>c. Manual castle key interlock required between two incomers</li> <li>d. Castle key for Local /Remote operation</li> </ul>				
4.2.2	Outgoing feeders	<ul style="list-style-type: none"> <li>a. The number of outgoing feeders from AC boards shall be such that each substation equipment is fed by separate feeder (refer below).</li> <li>b. Utilization category of MCBs shall be C.</li> </ul>				
	<b>Application</b>	<b>Type of Switchgear</b>	<b>No of Poles</b>	<b>Rating (A)</b>	<b>Quantity</b>	
4.2.3	Welding	MCB	2	63	1	
4.2.4	Power Socket	MCB	4	32	3	
4.2.5	Outdoor Lighting	MCB	4	16	2	
4.2.6	Indoor Lighting	MCB	4	16	2	
4.2.7	Battery Charger	MCB	4	32	2	
4.2.8	AC Supply	MCB	4	32	2	
4.2.9	Switchgear	MCB	2	32	2	
4.2.10	RTU/SCADA	MCB	2	16	2	
4.2.11	Fire Fighting	MCB	2	16	2	

**5 CONSTRUCTION**

5.1	General construction	<ul style="list-style-type: none"> <li>a. Board shall be of modular construction with provision for compartmentalization for Incomer and non-compartmentalization for outgoing feeders.</li> <li>b. It shall be free-standing type comprising dust-tight and vermin-proof sheet steel cabinets suitable for indoor installation with IP-54 degree of protection.</li> <li>c. Necessary busbar support insulators, cable glands, cable supports and terminal blocks etc. The board shall be of single front type.</li> </ul>
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**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

5.2	Material	The Board shall be made out of at least 2.5 mm thick cold rolled steel sheet (CRCA), suitably reinforced to provide flat level surfaces. No welds, rivets, hinges or bolts shall be visible from outside.
5.3	Equipment Mounting	a) All switches provided on the distribution board shall be on front side of the cabinets, operable from outside. b) All MCBs shall be flush mounted operable from front side of ACDB. c) All instruments and control devices shall be mounted on the front of cabinets and fully wired to the terminal blocks.
5.4	Operating Height	≤ 1.6 meter
5.5	Busbar housing	a) The busbars shall be housed in totally enclosed busbar chambers. b) Incoming connections from the busbar to various feeders shall be designed so as not to disturb cable connections. c) Busbar arrangement should ensure safety of the operation/maintenance personnel and facilitate working on any outgoing module without the need for switching off in-feed to the adjacent modules, as far as possible
5.6	Outgoing Cable Termination	For Outgoing cable termination, vertical arrangement of Terminal Blocks shall be provided with ratings in descending order.
5.7	Cable glands	Compression type cable glands shall be provided to hold the cables to avoid any pressure or tension on the terminal block connections.
5.8	Gland Plate	Gland plate shall be 3.0mm thick with metallic knockout punches
5.9	Doors	a) The doors of cable cabinets shall be lockable hinged type b) Doors shall be fitted with double lipped gaskets. c) Bus bar side shall have bolted doors.
5.10	Drawing Pocket	Shall be Provided to keep "As Built Drawings"

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD****6 BUSBAR**

6.1	Material	Busbar shall be of aluminum.
6.2	Size (phase and neutral)	a) Main busbar - 80x10 sqmm for Type 1 ACDB b) Main busbar – 50X10 sqmm for Type 2 ACDB c) Busbar dropper size Incomers - MCCB-80x10 sqmm for Type 1 ACDB d) Busbar dropper size Incomers - MCCB-50x10 sqmm for Type 2 ACDB
6.3	Supports	The busbar shall be supported by means of durable non-hygroscopic, non-combustible and non-tracking polyester fiberglass material or porcelain. Supports shall be capable of withstanding the maximum short circuit stresses
6.4	Sleeves and shrouds	Busbars shall be encased in heat-shrinkable sleeves of insulating material which shall be suitable for the operating temperature of busbars during normal service. The busbar joints shall be provided with removable thermosetting plastic shrouds.

**7 MCCB**

7.1	MCCB type	4 pole
7.2	MCCB design ambient temperature	50deg C
7.3	MCCB Housing	Thermoplastic material resistant to fire & abnormal heat , non hygroscopic
7.4	MCCB Terminal	Silver coated copper with phase barriers, spreader terminals & shrouds
7.5	De-rating at 50Deg ambient temperature	No derating (0%)
7.6	MCCB rated 3 phase short circuit breaking capacity Ics = Icu	36kA minimum at 415v and 50Hz
7.7	MCCB rated 3 phase short circuit withstand capacity, Icw	8kA for 1sec
7.8	MCCB SC making current capacity	75kA peak
7.9	MCCB rated insulation level	1000V
7.10	MCCB mechanical & electrical endurance	As per IS 13947 / IEC
7.11	MCCB utilization category	B as per IS / IEC 947
7.12	MCCB indications	ON, OFF & TRIP
7.13	MCCB protection	MCCBs shall have microprocessor based over current and earth fault release.



**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

7.14	Tripping characteristic required	
7.14.1	Overload setting	Range 60-100%In (Set on 95%)
7.14.2	Short Circuit setting	Range 200-1200%In (Set on 300%)
7.14.3	Earth fault setting	To be provided
7.15	MCCB Clearances in air	As per table XIII of IS 13947-1
7.16	MCCB temperature rise limits	As per table 2 & 3 of IS 13947-1
7.17	MCCB Ingress Protection	IP2X Minimum (pollution degree minimum 2)
7.18	MCCB additional features	Sealing/padlocking of operating knob in OFF position Sealing/padlocking of operating knob in OFF position isolation suitable with positive contact

**8 CURRENT TRANSFORMER**

8.1	Type	Cast-resin type, Class-E insulation, rated for 120% current continuous
8.2	Provision	Shall be provided in incomer for metering. Separate Neutral CT shall be connected in the neutral for detecting earth fault for both the incomer.
8.3	Secondary current	5A
8.4	Metering CT Class	1.0
8.5	Burden	Based on requirement

**9 TERMINALS AND WIRING**

9.1	Secondary Wiring	
9.1.1	Grade and type	1100 V grade, PVC insulated, FRLS type stranded flexible copper wire.
9.1.2	Ferruling	Each wire shall bear an identifying ferrule or tag at each end or connecting point.
9.1.3	Size	Appropriate size copper based on rated current and application subject to a minimum of 2.5sqmm copper
9.2	Terminals	Terminals of appropriate size shall be provided inside each cabinet for incoming and outgoing cables.
9.2.1	Grade	1100 V grade, molded piece terminals complete with insulated barriers, washers, nuts and lock nuts.
9.2.2	Power Terminals type	Stud type, nut driver operated

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

9.2.3	Control terminals type	Stud type, screw driver operated suitable for minimum 6sqmm wire.
9.2.4	Spare terminals	20% spare terminals should be provided in each terminal block.
9.2.5	Accessibility	Placement of terminals shall enable proper cable termination. Terminals shall be readily accessible for inspection and maintenance.
9.2.6	Marking	The terminals shall be serially numbered to facilitate installation and maintenance.
9.3	Cable troughs	Shall be provided for wiring of each terminal block with 50% spare capacity

**10 METERS, INDICATIONS AND PUSH BUTTONS**

10.1	Meters	
10.1.1	Multifunction Meter	For incomer feeders. Meter should have facility to store peak load current in memory.
10.1.2	Type	Digital with inbuilt phase selector
10.1.3	Communication Protocol	RS485 on MODBUS
10.1.4	Accuracy Class	1.0
10.1.5	Auxiliary supply	240VAC with 10% tolerance
10.2	Indicating lamps	Indicating lamps shall be of low wattage cluster LED type.
10.2.1	Incomer/ Outgoing On	Red
10.2.2	Incomer/ Outgoing Off	Green
10.2.3	Incomer/ Outgoing Trip	Amber
10.3	Push buttons	For manual operation of incomer

**11 NAME PLATES & MARKINGS**

11.1	Panel nameplate	Panel shall have a nameplate clearly indicating the following: a) Manufacturer's Name & Country: b) Panel Serial No.: c) Customer Name: BSES Yamuna / Rajdhani Power Ltd d) PO No. & date: e) Type of Panel: f) Current rating: g) Rated Voltage and Frequency: h) Month and year of Manufacture: MM/YYYY i) Guarantee period:
11.2	Feeder nameplate	Large and bold name plate carrying the feeder identification

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

		shall be provided on the top of each module. Blank insert type name plates shall be provided on each outgoing feeder.
11.3	Equipment nameplate	a) All equipment mounted on front side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. b) All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.
11.4	Danger plate	Panel shall have a danger plate of anodized aluminum clearly indicating the danger logo and voltage details.
11.5	Material	Non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering. Stickers are not allowed.
11.6	Fixing	All nameplates/rating plates shall be riveted to the panels at all four corners. Bolting/screwing is not acceptable.
11.7	Markings	Each switch shall bear clear inscription identifying its function. Similar inscription shall also be provided on each device whose function is not otherwise identified. If any switch or device does not bear this inscription separate nameplate giving its function shall be provided for it. Switch shall also have clear inscription for each position indicating e.g. Trip-Neutral close, ON-OFF etc.

**12 FINISHING**

12.1	Primer	Two coats
12.2	Finish	Powder Coating
12.3	Colour shade	RAL 7032 (Siemens Grey)
12.4	Paint thickness	70 microns (minimum)

**13 APPROVED MAKE OF COMPONENTS**

13.1	Switch	Siemens / L&T (Salzer)
13.2	HRC Fuse Links	GE/ Siemens/ L&T
13.3	Meters	Rishabh/Schneider/AE
13.4	AC Contractors	L&T/Siemens/Telemecanique/GE/ABB
13.5	Terminals	Connectwell/Elmex/Wago/Phoenix
13.6	Push buttons / Actuator	L&T/Siemens/Vaishno/Schneider
13.7	MCCB	L&T/Siemens/ ABB/GE/Schneider
13.8	MCB	Datar/Legrand/Hager/Schneider/ABB
13.9	Indicating lamps	Vaishno/Binay/Teknic/Siemens/Mimic/C&S

**14 QUALITY ASSURANCE PLAN, INSPECTION AND TESTING**

S No.	Parameters	Technical Requirements
14.1	Quality Assurance Plan	QAP Shall be submitted by vendor for approval. Inspection and testing of the material shall be carried out accordingly.
14.2	Type test	Equipment should be of type tested quality only, type test certificate to be submitted along with offer. Test reports from CPRI/ERDA accredited laboratory only acceptable.
14.3	Routine /Acceptance test	As per relevant Indian standard
14.4	Inspection	a) The buyer reserves the right to inspect equipment at the Seller's works at any time prior dispatch, to verify compliance with the specifications. b) In-process and final inspection call intimation shall be given in 15 days advance to purchaser. c) In the event of any discrepancy in the test reports i.e. test reports not acceptable or any type tests (including special /additional tests, if any) not carried out, same shall be carried out without any cost implication to BSES before dispatch of equipment.
14.5	Test certificates	Test certificates (routine and acceptance) shall be submitted along with the dispatch documents.

**15 PACKING, SHIPPING, HANDLING & SITE SUPPORT**

15.1	Packing Protection	The packing shall be fit to withstand rough handling during transit and storage at destination. The test set should be properly protected against corrosion, dampness & damage.
15.2	Packing for accessories and spares	Robust non-returnable packing case with all the above protection & identification Label. The bidder should get the packing list approved before dispatching the material.
15.3	Packing Identification Label	On each packing case, following details are required: a) Individual serial number b) Purchaser's name c) PO number (along with SAP item code, if any) & date d) Equipment Tag no. (if any) e) Destination f) Manufacturer / Supplier's name g) Address of Manufacturer / Supplier / it's agent h) Description i) Country of origin j) Month & year of Manufacturing

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

		k) Case measurements l) Gross and net weight m) All necessary slinging and stacking instructions
15.4	Shipping	The seller shall be responsible for all transit damage due to improper packing.
15.5	Handling and Storage	Manufacturer instruction shall be followed.
15.6	Detail handling & storage instruction sheet / manual to be furnished before commencement of supply.	

**16 DEVIATIONS**

16.1	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.
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**17 DOCUMENT SUBMISSION MATRIX**

Drawing submission shall be as per the matrix given below.

- All documents/ drawing shall be provided in soft copy only through mail.
- Language of the documents shall be English only.
- Incomplete submission shall be liable for rejection.
- Document check sheet compliance shall be the first sheet for each submission stage i.e. Technical bid, Drawing Approval, Pre Dispatch
- No submission is acceptable without check list compliance.
- Order of documents shall be strictly as per the check list.
- Any drawing not included in the below table but necessary for detailed engineering shall be deemed to be included in bidder's scope.

<b>S No.</b>	<b>Documents to be submitted</b>	<b>Bid</b>	<b>Approval</b>	<b>Pre Dispatch</b>
17.1	Guaranteed Technical Particulars (GTP)	Required	Required	
17.2	Deviation Sheet, if any	Required	Required	
17.3	GA drawing, SLD, Wiring Diagram	Required	Required	

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

<b>S No.</b>	<b>Documents to be submitted</b>	<b>Bid</b>	<b>Approval</b>	<b>Pre Dispatch</b>
17.4	Type test reports(not more than 5 years old) from CPRI/ERDA	Required	Required	
17.5	Reference List of major customers using the offered product from last 5 years	Required		
17.6	Performance certificates executed in last 5 years			
17.7	Make of Raw Materials	Required	Required	
17.8	Manufacturer's Quality Assurance Plan		Required	
17.9	Complete product catalogue and Manual		Required	Required
17.10	Test certificates of all raw materials			Required
17.11	Inspection and routine test reports, carried out in manufacturer's works			Required

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD****ANNEXURE AGUARANTEED TECHNICAL PARTICULARS**

S. No.	Description	Specification requirement	Vendor Data
<b>1.0</b>	<b>GENERAL FEATURES</b>		
1.1	Make		
1.2	Type		
1.3	Reference Standard		
1.4	Rated Operational voltage	415V AC $\pm$ 10%	
1.5	Rated Nominal Current	630A	
1.6	Rated frequency	50 Hz (+3%, -5%)	
1.7	Rated Insulation voltage	1100V	
1.8	Rated Impulse withstand voltage	8kV	
1.9	Service supply for heating, lighting and power sockets	240VAC $\pm$ 10%,	
1.10	Mounting	Floor (Free standing)	
1.11	Connections	Cable entry – Bottom	
1.12	Configuration	Single front	
1.13	Enclosure thickness		
1.13.1	Load Bearing Member	$\geq$ 2.5mm	
1.13.2	Doors and Covers	$\geq$ 2 mm	
1.14	Enclosure Material	CRCA Sheet/GI	
1.15	Enclosure degree of protection	IP 54	
1.16	Mechanical safety interlocks	As specified in technical specification	
1.17	Incomer Power Cable Termination	2Rx4Cx300sqmm	
	Outgoing Cable Termination	a) 200A MCB- 4Cx150sqmm b) 63A MCB- 4Cx50sqmm c) 32A MCB- 4Cx25 sqmm d) 16A MCB- 2Cx10 sqmm	
	Cable Termination Type	From Bottom of Panel	
	Clearance	150 mm clearance to be maintained from the bottom of the TB and the gland plate	
1.18	Paint shade	RAL 7032 (Siemens Grey)	
1.19	Typical vertical section (Overall dimension (mm) and weight ( Kg))	Required	
1.19.1	Incomer		
1.19.2	Outgoings		
1.20	Dimensions of the ACDB Panel	L (mm) X D (mm) X H (mm)	

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

S. No.	Description	Specification requirement	Vendor Data
1.21	Weights of the ACDB Panel	(in kg.)	
1.22	Marking on the panel	As per the specification	
<b>2.0</b>	<b>INCOMER MCCB</b>		
2.1	Make & Model of MCCB	Required	
2.2	Catalogue of MCCB	Required	
2.3	Continuous Current at 40 deg C/ 50 deg C	630A	
2.4	Rated ultimate breaking capacity at rated voltage	50kA	
2.5	Rated service breaking capacity Ics	Ics = 100% Icu at rated voltage	
2.6	Rated making current	Icm = 220% Icu	
2.7	Utilization Category	A	
2.8	Overload setting	50 -100% (Inverse time characteristics)	
2.9	Overcurrent setting	200-1000% (Instantaneous characteristics)	
2.10	Earthfault setting	20-100% (Instantaneous)	
2.11	Dimension(HxWxD)	Required	
2.12	Weight	Required	
<b>3.0</b>	<b>BUS AND BUS TAPS</b>		
3.1	Make		
3.2	Material and grade of buses and joints	High conductivity electrolytic grade aluminum	
3.3	Reference standard		
3.4	Continuous Current (at site condition, 50°C ambient) within cubicle	630A	
3.5	Cross sectional Area		
3.6	DC resistance	ohm/m/ph	
3.7	Skin-effect ratio		
3.8	Reactance	ohm/m/ph	
3.9	Losses-middle phase	w/m/ph	
3.10	Minimum clearance of bus bar and joints	Required	
3.10.1	Phase to phase (mm)		
3.10.2	Phase to earth (mm)		
3.11	Bus bar insulation	a. Heat shrinkable sleeves rated for maximum operating voltage b. Cast resin shrouds for joint	



**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

<b>S. No.</b>	<b>Description</b>	<b>Specification requirement</b>	<b>Vendor Data</b>
3.12	Bus joints	Silver	
3.13	Bus bar support insulator	Required	
3.13.1	Spacing (mm)		
3.13.2	Make		
3.13.3	Type		
3.13.4	Reference standard		
3.13.5	Voltage class (kV)		
3.13.6	Minimum creepage distance (mm)		
3.13.7	Cantilever strength (Kg/sq.cm.)		
<b>4.0</b>	<b>CURRENT TRANSFORMER</b>		
4.1	Make		
4.2	Type	Resin Cast	
4.3	Reference standard		
4.4	CT ratios		
4.5	Class of Insulation	Class-E	
4.6	Protection class	5P20	
4.7	Metering class	5	
4.8	VA burden for Relaying CT-Incomer	Based on requirement.	
<b>5.0</b>	<b>AMMETERS/MULTIFUNCTION METERS AND VOLTMETERS</b>		
5.1	Make & Model no.		
5.2	Type	Digitalwith inbuilt phase selector	
5.3	Communication Protocol	RS485 on MODBUS	
5.4	Accuracy class	1	
<b>6.0</b>	<b>CONTROL &amp; INDICATIONS</b>		
6.1	Push button		
6.1.1	Make and model no.		
6.1.2	Type	Flush mounted type with touch proof terminals	
6.2	LEDs		
6.2.1	Make & Model no.		
6.2.2	Type	Flush mounted type with touch proof terminals	
<b>7.0</b>	<b>TERMINAL BLOCKS</b>		
7.1	Make & Model no.		
7.2	Spare terminals	Equal to 20% of active terminals in each TB	
7.3	Power terminals	Stud type, screw driver operated	

**TECHNICAL SPECIFICATION FOR 415V AC DISTRIBUTION BOARD**

<b>S. No.</b>	<b>Description</b>	<b>Specification requirement</b>	<b>Vendor Data</b>
7.4	Control terminals	Stud type, screw driver operated suitable for minimum 6sqmm wire.	
<b>8.0</b>	<b>TESTS</b>		
8.1	Confirmation of routine tests to be performed as per IS 60947	Yes/No	
8.2	IP 55 test shall be carried out during inspection	Yes/No	
8.3	Confirmation of Type tests to be performed (or report submitted) as per IS 60947	Type test report no./date	
8.4	Confirmation of Acceptance tests to be performed during inspection as per IS 60947	Yes/No	
8.5	Temperature rise test to be carried out at NABL accredited lab.	Yes/No	
<b>9.0</b>	Deviation sheet against each clause of the specification	To be submitted	



## Technical Specification

For

### Grounding and Lightning Protection System

Specification no – BSES-TS-76-GES-R0

Rev:	0	
Date:	06 May 2022	
Prepared by	Bhanu Gehlot	
	Uttam Shukla	
Reviewed by	Abhinav Srivastava	
Approved by	Gopal Nariya	

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**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM****1. SCOPE**

This specification covers the guidelines of earthing & lightning protection at 66/11, 33/11, 66/33/11 kV Grid substation and the technical requirements of material required for earthing system.

**2. STANDARDS & CODES**

2.1.	CEA guidelines	Technical standards for construction of electrical plants and electrical lines
2.2.		IE Rules of 1956
2.3.	IEEE Std 80	IEEE guide for safety in AC substation grounding
2.4.	CBIP :2006 – publication no. 229	Manual on substation layout
2.5.	IS 3043: 1987	Code of practice for earthing
2.6.	IS 2629 (1985)	Recommended practice for hot dip galvanizing of Iron & Steel
2.7.	IS 2633 (1986)	Method for testing uniformity of coating on zinc coated article
2.8.	IS 5358 (1969)	Specification for hot dip galvanized coating on fasteners
2.9.	IS 4759 (1996)	Specification of Hot dip zinc coatings on structural steel and other allied products
2.10.	IS 1239 (2004)	Steel tubes, tubular and other wrought steel fittings- specification
2.11.	IEC 62561-2	Requirements for conductors and earth electrodes
2.12.	IEC 62561-7	Requirements for earthing enhancing compounds
2.13.	UL 467	Standard for safety - Grounding and bonding equipment
2.14.		Handbook on Electrical Earthing (Ministry of Railways)

**3. REQUIREMENT OF EARTHING**

3.1.	Primary guidelines	Following are primary guidelines for a good earthing system in a Grid substation: a. The impedance to ground should be as low as possible. In general it should not exceed <b>0.5ohm</b> . b. The step and touch potentials shall be within safe limits. c. The contractor shall do the calculation for number of earthing rods being used in a substation for achieving the desired earth resistance.
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**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

3.2.	Design Parameters	<p>Earthing Calculation parameters shall be taken as:</p> <ol style="list-style-type: none"> <li>1) Duration of shock current <math>t_s=1</math>sec.</li> <li>2) Top Gravel resistivity shall be 3000 Ohm Meter.</li> <li>3) Split/ Diversion Factor shall be considered as 1</li> <li>4) Earth conductor/ electrodes size calculation based upon corrosion considered for next 40 years.</li> <li>5) The final diameter of earth conductors/rod shall be maximum of calculated dia or 25 mm (prescribed in clause 5)</li> </ol>
3.3.	Earthing lead size	<ol style="list-style-type: none"> <li>a. The actual size of earthing lead will depend on the maximum fault current which the earthing lead will be required to carry safely.</li> <li>b. Please refer <b>AnnexureA1</b> for HT fault level.</li> </ol>
3.4.	Earthing type	<ol style="list-style-type: none"> <li>a. Rod earthing shall be provided for the Grid substation.</li> <li>b. The size of the rod depends upon the current to be carried and the type of the soil. Soil resistivity testing will be carried out by vendor.</li> <li>c. The Earth Electrode should be embedded vertically. Wherever hard rock is encountered, the rod can be inclined at an angle of about 30deg to the horizontal as per clause 9.2.2 of IS 3043.</li> <li>d. The vertically driven rods shall be interconnected with each other using horizontal grid conductors.</li> </ol>
3.5.	Earth Pit	<ol style="list-style-type: none"> <li>a. As per clause 20.5.2 of IS 3043, the minimum distance between the vertical earth electrodes shall not be less than the length of rod.</li> <li>b. Minimum of 1m distance of earth pit from electrical equipment and structures shall be maintained.</li> <li>c. The earth pits shall be backfilled with earth enhancing material as per Drawing .</li> <li>d. Treated Earth pits shall be used where earth resistance value is getting over the prescribed value in specification i.e. 0.5 ohms.</li> <li>e. Treated Pipe earthing required for 2 nos. each for PTR &amp; Station TRF neutral and RTU/ SCADA.</li> <li>f. 50% quantity of the total earth electrodes to be provided with earth enhancing material (Terec++/ marconite).</li> </ol>
3.6.	Horizontal Conductor	<ol style="list-style-type: none"> <li>a. The entire earth rod driven in ground vertically shall be interconnected with earth grid conductors horizontally under the ground.</li> <li>b. The Horizontal conductors shall be laid 600mm below FGL.</li> <li>c. Minimum earth coverage of 300 mm shall be provided between the Horizontal conductor and the bottom of trench/foundation/underground pipe at the crossing.</li> <li>d. Horizontal conductors around a building /switchyard fence shall be buried outside the boundary at a minimum distance of 2000 mm.</li> <li>e. Risers shall be provided 300mm above the ground level for equipment earthing. Two number treated earth pits shall be provided with riser for connection of transformer neutral.</li> <li>f. All the joints between rods flats shall be <b>exothermic</b> type for creating better electrical contact between two. Welding between rods to flat, flat to flat should be arc welding type.</li> <li>g. Wherever bolted connection is done, it shall be done through two bolts at each joint to ensure tightness and avoid loosening with passage of time.</li> <li>h. Where a 66 kV overhead line terminates at the substation, a</li> </ol>

**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

		<p>metallic continuity between the end tower and the substation earth grid should be established with two independent connections.</p> <p>i. To ensure good welding, it should be carried out only after scratching off the galvanization, dirt, grease etc by thorough cleaning of contact surface. After welding it will be made with anticorrosive zinc rich paint.</p>
3.7.	Equipment earthing	<p>a. GI strips shall be used for the equipment earthing.</p> <p>b. Two separate and distinct earth connections shall be provided for earthing of electrical frameworks.</p> <p>c. The connection of GI strip with riser of earth mat shall be electric arc welding arrangement; connection of equipment with earthing end shall be double bolted arrangement.</p> <p>d. The transformer neutral shall be earthed with two independent grounding conductors connected to two separate earth pits.</p> <p>e. Fence within the earth grid shall be bonded to the plant earth system at regular interval not exceeding 10 meters. Fence gate shall be separately earthed with flexible Copper braid to permit movement.</p> <p>f. Bolted connection shall be made only for earthing of equipment/devices and for some removable structures. The contact surfaces shall be thoroughly cleaned before connection to ensure good electrical contact.</p> <p>g. Cable armor shall be earthed at both ends for multi core cables. For single core cables, the earthing shall be at switchgear end only.</p> <p>h. For prefabricated cable trays, a separate ground conductor shall run along the entire length of cable tray and shall be suitably clamped on each cable tray at periodic intervals. Each continuous laid out lengths of cable tray shall be earthed at minimum two places by GS flats to Owner's earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earthmat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground.</p> <p>i. Earthing conductor's crossings the road shall be installed at 1000 mm depth and where adequate earth coverage is not provided it shall be installed in Hume pipes. Earthing conductors embedded in the concrete floor of the building shall have approximately 50mm concrete cover.</p> <p>j. Metallic stairs and hand rails shall be earthed as for columns. Additionally a 25x6 GI flat shall run the entire length of the stairs. The GI flat shall be welded to the stairs and hand rails at intervals of 1500 mm.</p> <p>k. The main earth conductor shall be securely fixed to the columns /walls/trays by welding /clamping at the intervals not exceeding 1500 mm. The earth conductors shall be interconnected between them and to the main earth grid through risers.</p> <p>l. <b>In case of GIS substation, earthing rods to be considered in RCC floor as per GIS OEM recommendation.</b></p>
3.8.	Lightening protection	<p>a. Direct stroke lightning protection (DSLPP) shall be provided in the EHV switchyard by shield wires/ High mast spike gaurd. The final arrangement shall be decided after approval of the DSLPP calculations. The Contractor is required to carry out the DSLPP</p>

**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

		<p>calculations and submit the same to the Owner for approval of the same at detailed engineering stage after award of contract.</p> <p>b. DSLP protection shall be provided for control room building as per design calculation following Indian standards. The down conductor should be high conductivity bare copper tape with minimum size of 75 sqmm.</p> <p>c. Connection between each down conductor &amp; Test link shall be located approximately 2000mm above ground Level.</p> <p>d. Separate earth electrodes shall be provided for building DSLP connecting the down conductors to the risers &amp; finally to the Earthmesh. Minimum electrodes to be provided – 4 Nos.</p>
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**4. SPECIFICATION OF EARTHING MATERIALS**

4.1.	GI earthing strip	<p>a. Fully galvanized iron strips shall be used conforming to IS 2629.</p> <p>b. The zinc deposition shall not be less than 610gm/sqm of the galvanized surface area of the MS Earthing strips.</p> <p>c. The zinc coating used for the galvanization shall be of 9.99 % purity grade as per IS 209.</p> <p>d. All the galvanized material shall be checked for uniformity and weight as per IS.</p> <p>e. The standard length of galvanized iron earthing strip shall be minimum 7Mtrs.</p>
4.2.	Vertical and Horizontal Earth Electrode	<p>a. Copper clad steel rod driven in the earth vertically shall be a high tensile-low carbon steel rod of adequate diameter(as per the clause 6.0 of the specs) and 3m length complying UL467, IEC62561-2 and IS 3043, molecularly bonded by 99.99% pure high conductivity copper on the outer surface with copper coating thickness 254 microns or more with sufficient amount of earth enhancement compound as per IEC 62561-7.</p> <p>b. Copper bonding must be UL/CPRI/ERDA certified.</p> <p>c. Rod shall be tested and certified from CPRI/ERDA for a short circuit current withstanding of desired value.</p> <p>d. There shall be following marking on the rod-Dimension Detail, product model no, Reference number of certification.</p> <p>e. It shall have high corrosion resistance and shall eliminate electrolytic action.</p> <p>f. The rod shall have thread profile at both the ends to ensure no copper is removed from the steel.</p>



**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM****5. SIZES OF THE EARTHING MATERIALS FOR EQUIPMENT EARTHING**

S.No.	Title	Material	Sizes of the earthing	Type	UOM	No of Lead
	<b>Main Earthing Grid</b>					
5.1	Vertical Rods	Cu Bonded Rods	25	Rod	mm (dia)	
5.2	Above Ground risers	GI	50x10	Flat	Sqmm	2
5.3	Horizontal Rods	Cu Bonded Rods	25	Rod	mm (dia)	
5.4	Treated Earth Pit	Cu Bonded Rods	25	Rod	mm (dia)	
	<b>Power Transformers</b>					
5.5	Frame	GI	75X10	Flat	Sqmm	2
5.6	Marshalling Box	GI	50X6	Flat	Sqmm	2
5.7	Radiator	GI	50X6	Flat	Sqmm	2
5.8	Neutral	GI	75X10	Flat	Sqmm	2
5.9	Fan	GI		As per sizes mentioned for fans		
	<b>11 KV System</b>					
5.10	11 KV Switcgear	GI	50X6	Flat	Sqmm	2
5.11	11 KV Bus Duct	GI	50X6	Flat	Sqmm	2
5.12	11 KV Cable Box	GI	50X6	Flat	Sqmm	2
	<b>415 V System</b>					
5.13	ACDB	GI	50X6	Flat	Sqmm	2
5.14	Station Trafo Frame	GI	50X6	Flat	Sqmm	2
	<b>DC System</b>					
5.15	Battery Charger	GI	50X6	Flat	Sqmm	2
5.16	DCDB	GI	50X6	Flat	Sqmm	2

**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

	<b>Other Electrical Items</b>					
5.17	Three phase receptacles, welding outlet	GI	25x3	Flat	Sqmm	1
5.18	C&R Panel	GI	50X6	Flat	Sqmm	2
5.19	Push Button	GI	8	Wire	Swg	1
5.20	Cable Trays(one run along the tray section)	GI	50X6	Flat	Sqmm	1
	<b>Other Non Electrical Items</b>					
5.21	Railway Tracks	GI	25x6	Flat	Sqmm	At suitable Points
5.22	Metallic noncurrent carrying structures like stair case	GI	25x6	Flat	Sqmm	1
5.23	Columns, Structures	GI	50X6	Flat	Sqmm	2
5.24	Steel pipe racks	GI	25x6	Flat	Sqmm	1
5.25	Fence/Gate	GI	50X6	Flat	Sqmm	As per clause 3.7 (e)
5.26	Hand Rail	GI	8	Wire	Swg	1

**6. TESTING AND INSPECTION**

6.1.	Earthing materials	<p>a. The purchaser reserves the right to inspect the material at the time of tests. All tests shall be performed in the presence of BYPL/BRPL representative. The bidder shall give intimation in advance to witness the test.</p> <p>b. Acceptance test for GI earthing strips – Tests for Visual examination, dimensional verification and galvanization shall be witnessed at the time of inspection.</p> <p>c. Acceptance test of Earth enhancement compound – Tests for leaching, sulphur determination, corrosion and resistivity shall be done as per IEC 62561-7</p> <p>d. Type test reports of the earthing materials from CPRI/ERDA/Equivalent lab shall be submitted. The bidder shall submit UL-467/CPRI/ERDA test reports for copper clad steel rod.</p>
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**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

6.2.	Measurement of Earth resistance	<p>a. After the completion of work ground resistance of each installation shall be measured by BYPL/BRPL/Contractor.</p> <p>b. The measurement of resistance shall be witnessed and signed by representative of BYPL/BRPL as well as the contractor. The test certificates shall be generated for each installation clearly indicating the details of the transformer, name of the substation, location, district, serial no. of testing equipment and name of testing engineer.</p> <p>c. The desire ground resistance shall be measured after interconnection of earth pits is completed. The value of earth resistance shall not be more than <b>0.5 ohm</b>.</p> <p>d. In case where this value exceeds 0.5 ohms, the earthing design shall be redesigned. The pit location, earth electrode, soil treatment, earth conductor, GI strip used shall be checked whether properly used at site. If not, these shall be changed as per the redesigned plan.</p>
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**7. DEVIATIONS**

7.1.	Deviation	<p>Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.</p>
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**8. DOCUMENTS SUBMISSION**

The bidder has to submit the following documents along with bid:-

8.1.	Complete earthing calculation
8.2.	Complete product catalogue, Manual and calibration certificate of the equipment
8.3.	Type test reports
8.4.	Deviation Sheet (if any)

**9. GUARANTEED TECHNICAL PARTICULARS**

S. No	Parameter	BYPL/BRPL Requirement	Vendor Data
9.1	Rod to rod welding	Exothermic	
9.2	Zinc deposition of GI earthing Strip	610gm/sqm	
9.3	Length of GI Strip	7m (Minimum)	

**TECHNICAL SPECIFICATION FOR GROUNDING AND LIGHTENING PROTECTION SYSTEM**

9.4	Diameter of Cu clad Rod	25 mm or calculated Dia whichever is higher	
9.5	UL/CPRI/ERDA Certification of Cu Bonding	Test certificate to be provided	
9.6	Cu bonding	250 Micron	
9.7	Length of Copper bonded rod	3 m	
9.8	Purity of Copper	99.99%	
9.9	Short circuit withstand test of Rod	31.5kA	
9.10	Marking on the rod-Dimension Detail, product model no, Reference number of certification	Sample Required	
9.11	ROHS Certificate from NABL accredited lab for not having toxic chemical in earth enhance material	Test certificate to be provided	
9.12	Resistivity of earth enhancing material	0.12 ohm-m(Max)	
9.13	Exothermic welding material	IEEE 837 Complied	
9.14	Make of Steel	SAIL/ESSAR/TATA	

**ANNEXURE A1 : REFERENCE FAULT LEVEL**

<b>Voltage Level(kV)</b>	<b>Design Fault Level</b>
66/11	31.5 KA
33/11	25 KA



Technical Specification of  
LT Power Cable(Single & Multi-Core)

Specification no – BSES-TS-01-LTPC-R0

Rev:	0	
Date:	31 Mar 2022	
Prepared by	Abhishek Vashistha	
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Reviewed by	Puneet Duggal	
	Amit Tomar	
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	K. Sheshadri	

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**TECHNICAL SPECIFICATION OF LT POWER CABLE****1.0 SCOPE OF SUPPLY**

The specification covers design, manufacture, shop testing, packing and delivery of 1100 Volts grade, Aluminium conductor XLPE insulated power cables.

**2.0 CODES & STANDARDS**

The cables shall be designed, manufactured and tested in Accordance with the following Indian & IEC standards.

2.1	IS- 7098 (Part-1)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
2.2	IS- 6474	Polyethylene insulation & sheath of electric cables.
2.3	IS- 5831	PVC insulation and sheath of electrical cables.
2.4	IS : 10810	Methods of tests for cables.
2.5	IS : 8130	Conductors for insulated electrical cables and flexible cords.
2.6	IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables.
2.7	IS- 4026	Aluminum ingots, billets and wire bars (EC grade)
2.8	IS-5484	EC Grade aluminium rod produced by continuous casting and rolling
2.9	IS : 10418	Specification for drums for electric cables.
2.10	IS : 3961	Recommended current ratings for cables.
2.11	IS:1255	Installation and Maintenance of power cables upto and including 33 kV rating.
2.12	IS:4826	Specification for hot-dipped galvanized coatings on round steel wires
2.13	IS:1717	Metallic Materials – Wire – Simple torsion test
2.14	IEC 60228	Conductors of insulated cables. Guide to the dimensional limits of circular conductors.
2.15	IEC 60331	Fire resisting characteristics of electric cables.
2.16	IEC 60332 – 3	Tests on electric cables under fire conditions. Part 3: Tests on bunched wires or cables.
2.17	IEC 60502	Extruded solid dielectric insulated power cables for rated voltages from 1kV to 30 kV.
2.18	IEC 60754 – 1	Test on gases evolved during combustion of materials from cables. Part 1: Determination of the amount of halogen acid gas evolved during combustion of polymeric material taken from cables.
2.19	IEC 60811	Common test methods for insulating and sheathing materials of electric cables
2.20	IEC 60885	Electric test methods for electric cables
2.21	IEC 60304	Standard colours for insulation for low frequency cables and wires.
2.22	IEC 60227	PVC insulated cables of rated voltages up to and including 460/760 V.

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

2.23	IEC 1034	Measurement of smoke density of electric cables burning under defined conditions
2.24	ASTMD 2843	Standard Test Method for density of Smoke from the burning or decomposition of cables
2.25	ASTM 2863	Standard Test Method for measuring of minimum oxygen concentration
2.26	IEC 60754-1	Test on gases evolved during combustion of materials for cables. Part 1 – Determination of the Halogen Acid gas Content
2.27	IS 1554 part 1	Specification for PVC insulated (Heavy duty) Electric cable

**3.0 CABLE DESIGN**

Description of each item mentioned in the specification (the text, BOQ, GTP or any site specific requirement) shall be followed along with IS: 7098 – P1

3.1	Conductor	a) Electrolytic Grade Stranded Aluminium Conductor												
		b) Grade: H2 as per IS: 8130/1984												
		c) Class 2												
		d) Chemical Composition as per IS 4026												
		e) Shape & Size:												
		<table border="1"> <thead> <tr> <th>S. no.</th> <th>Shape</th> <th>Single core (sq.mm)</th> <th>Multi core (sq.mm)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Compacted Circular</td> <td> <ul style="list-style-type: none"> <li>• 1cx25</li> <li>• 1cx95</li> <li>• 1cx300</li> <li>• 1cx630</li> <li>• 1cx1000</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>• 2cx10</li> </ul> </td> </tr> <tr> <td>2</td> <td>Sector</td> <td>---</td> <td> <ul style="list-style-type: none"> <li>• 2cx25</li> <li>• 4cx25</li> <li>• 4cx50</li> <li>• 4Cx150</li> <li>• 4Cx300</li> <li>• 4Cx400</li> </ul> </td> </tr> </tbody> </table>	S. no.	Shape	Single core (sq.mm)	Multi core (sq.mm)	1	Compacted Circular	<ul style="list-style-type: none"> <li>• 1cx25</li> <li>• 1cx95</li> <li>• 1cx300</li> <li>• 1cx630</li> <li>• 1cx1000</li> </ul>	<ul style="list-style-type: none"> <li>• 2cx10</li> </ul>	2	Sector	---	<ul style="list-style-type: none"> <li>• 2cx25</li> <li>• 4cx25</li> <li>• 4cx50</li> <li>• 4Cx150</li> <li>• 4Cx300</li> <li>• 4Cx400</li> </ul>
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3.2	Insulation	Extruded XLPE insulation as per IS : 7098 part-1												
3.3	Core Identification	a) Single Core Cable – Natural b) Two Core Cable – Red & Black c) Four Core Cable – Red, Yellow, Blue and Black												
3.4	Inner Sheath	a) For Single Core Cable – Inner Sheath Not Required b) For 2 Core cable- Pressurized Extruded, Black PVC type ST-2 (IS 5831-1984) c) For 4 core cable –Extruded Black PVC type ST-2 (IS 5831-1984)												
3.5	Armour	a) For 2C X 10 mm <sup>2</sup> – Galvanized Steel round wire. b) For all sizes above 10 mm <sup>2</sup> -Galvanized Steel Strip c) Armour not required for single core cables d) Minimum area of coverage of armouring shall be 90%												



TECHNICAL SPECIFICATION OF LT POWER CABLE

		<p>e) The breaking load of armour joint shall not be less than 95% of that of armour wire / strip</p> <p>f) Zero negative tolerance for thickness of armour strip shall be as per IS:3975</p> <p>g) Zinc rich paint shall be applied on strip/wire and its joint surface.</p>
3.6	Outer Sheath	<p>a) Extruded FRLS outer sheath of PVC (ST-2) shall be as per IS:5831</p> <p>b) Colour :</p> <ul style="list-style-type: none"> <li>• For multi core cables-<b>Orange/Yellow as per tender requirement</b></li> <li>• For single core cables – <b>Orange/Black as per tender requirement</b></li> </ul> <p>c) FRLS Outer sheath of all the LT cables shall be UV resistant; as these cables are laid in air exposed to sun. Bidder to ensure the same for these requirements supported by required test.</p> <p>d) Shape of the cable over the outer sheath shall be circular, when manufactured/completed.</p> <p>e) The FRLS outer Sheath shall be embossed with following minimum text:</p> <ol style="list-style-type: none"> <li>i) The voltage designation</li> <li>ii) Type of construction /cable code (For e.g. A2XWY/A2XFY)</li> <li>iii) FRLS</li> <li>iv) Manufacture name/Trade mark</li> <li>v) Number of Cores and nominal cross section area of conductor</li> <li>vi) Name of buyer i.e BSES</li> <li>vii) Month &amp; year of manufacturing</li> <li>viii) IS reference , i.e. IS:7098</li> <li>ix) P.O No. and Date</li> <li>x) Font size shall be 5/5mm</li> <li>xi) ISI mark</li> </ol> <p>The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.</p> <p>Following points shall be printed on every meter of cable</p> <ol style="list-style-type: none"> <li>i. Progressive (Sequential) length of cable at every meter, starting from zero for every drum. Colour filled in for the progressive marking, shall be with proper contrast in colouring.</li> <li>ii. Drum number marking on every meter of the cable length</li> </ol>
3.7	Bending Radius	Bending Radius of cable shall comply to IS:1255
3.8	Sealing of cable end	Both ends of the cable shall be sealed by means of non-hygroscopic

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		heat shrinkable PVC caps
3.9	FRLS Properties	Oxygen Index : Not less than 29% as per ASTM 2863
		Temperature Index : 250 Deg C at Oxygen Index 21 (when tested as per ASTM D 2863)
		Max Acid Gas Generation – Not more than 20% as per IEC -60754-1
		Light Transmission - Minimum 40% when tested as per ASTM D 2843 (Smoke Density rating shall be max 60%)
		Flammability Test – IEC 60332 part -1

**4.0 CABLE DRUM**

4.1	Reference Standard	Cable drum shall comply with IS: 10418.
4.2	Type of Drum	Wooden drums with anti termite treatment. (The drums shall be provided with M.S spindle plate and nut-bolts arrangement as per IS : 10418 )
4.3	Drum Length & Tolerance	<ul style="list-style-type: none"> <li>• For 2C X 10 mm<sup>2</sup> Cable - 1000+/-5% Mtr</li> <li>• For all Other cable sizes - 500 +/-5% Mtr</li> </ul>
4.4	Overall Tolerance	-2 % for the total cable length for the entire order.
4.5	Short Length of Cable	<p>a) Minimum acceptable length (Max. is 525 mtr) shall be 1 % of the total ordered qty. &amp; no length shall be less than 250 mtr. Manufactures shall be taken prior approval from BSES Engineering for any short length supply. Short length will be accepted in last lot.</p> <p>b) Manufacture shall not be allowed to put two cable pieces of different short length in same cable drum</p>
4.6	Preventive Measure for cable Drum	<p>a) The surface of the drum and outer most cable layer shall be covered with water proof layer</p> <p>b) Ferrous part of wooden drum shall be treated with suitable rust preventive paint/coating to minimize rusting during storage.</p>
4.7	Drum Identification Labels	<p>a) Drum identification number</p> <p>b) Cable voltage grade</p> <p>c) Cable code (eg. A2XFY/A2XWY)</p> <p>d) Number of cores and cross sectional area</p> <p>e) Cable quantity i.e cable length (Meters)</p> <p>f) Purchase order number, date &amp; SAP item code</p> <p>g) Total weight of cable and drum (kg)</p> <p>h) Manufacture’s and Buyer’s name</p> <p>i) Month &amp; year of manufacturing</p> <p>j) Direction of rotation of drum; an arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.</p> <p>k) Cable length final end-marking (i.e reading at the inner end</p>

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		and reading at the outer end, just before packing shall be marked on the drum.
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**5.0 PACKING, SHIPPING, HANDLING & STORAGE**

5.1	Shipping information Plan	The seller shall be give complete shipping information concerning the weight ,size of each package
5.2	Transit Damage	The seller shall be held responsible for all transit damage due to improper packing/inside cable damaged found in store/site
5.3	Cable Drum Handling	The drum shall be with M.S spindle plate( with nut –bolts) of adequate size to suit the spindle rod , normally required for handling the drums , according to expected weight of the cable drums as per IS:10418

**6.0 QUALITY ASSURANCE, TESTING& INSPECTION**

All the tests shall be carried out in accordance with IEC / IS standards.

6.1	Quality Assurance Plan	In event of order manufacturer has to submit the signed copy of QAP.
6.2	Inspection hold points	AS per approved QAP (QAP shall be approved at the time of GTP approval)
6.3	Routine Test	a) Measurement of Electrical Resistance b) HV test with power frequency AC voltage
6.4	Type Test	<b>For bid participation–</b> (a) Bidder must be submitted cable type tested report from CPRI/ERDA/NABL approved lab for the type, size & rating of similar or higher sizes of offered cable along with bid. <b>After award of P.O.-</b> (b) If a bidder has valid type test report from CPRI/ERDA lab for the type, size & rating of similar or higher sizes of offered cable (including FRLS)—No need to conduct fresh type test from CPRI/ERDA lab. (c) If a bidder has valid type test report from CPRI/ERDA lab for the type, size & rating of similar or higher sizes of offered cable (except FRLS)—Need to conduct only fresh type test of FRLS properties test from CPRI/ERDA/NABL lab(list of tests mentioned in clause 3.9)without any commercial implication to BSES. (d) If a bidder has valid type test report from NABL lab for the type, size & rating of similar or higher sizes of offered cable (including FRLS)—Need to conduct complete type test (including FRLS properties) from CPRI/ERDA lab without any

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		<p>commercial implication to BSES. (Type test shall not be more than 5 years old. If the type test report is more than 5 years old (max 10 years), it can be considered subject to no change in their design)</p> <p>(e) UV resistance test to be carried out on one sample from CPRI/ERDA/NABL Accredited Lab as per ASTM standard (sample shall meet minimum 80% retention in tensile strength and elongation after exposure of 21 days as per ASTM standard).</p>
6.5	Acceptance Test (Shall be conducted as per Cl.15.2 of IS 7098 Part-1 & IS 1554 part 1 for each lot of cable)	<p>a) For cable sizes up to 25 mm<sup>2</sup> – one sample for chemical composition and purity test of aluminium shall be conducted per 300km of ordered quantity and multiple thereof.</p> <p>b) For cable sizes 50mm<sup>2</sup> – one sample for chemical composition and purity test of aluminium shall be conducted per 100km of ordered quantity and multiple thereof.</p> <p>c) For cable sizes above 50 mm<sup>2</sup> – one sample for chemical composition and purity test of aluminium shall be conducted upto 50km of ordered quantity and multiple thereof.</p> <p>d) Chemical composition and purity test of aluminium shall be conducted from the lot offered to BSES on each size involved in the purchase order. Test shall be carried out at NABL accredited third party lab without any price implication to BSES.</p> <p>e) The sample will be selected either during acceptance test or after receipt of cable in BSES Stores.</p>
6.6	Inspection	<p>a) The buyer reserves the right to witness all tests specified on completed cables</p> <p>b) The buyer reserves the right to inspect cables at the seller's works at any time prior to dispatch either in finished form or during manufacturing, to prove compliance with the specifications.</p> <p>c) In-process and final inspection call intimation shall be given in 10 days advance to purchaser/CES.</p>
6.7	Test Certificates	Complete test certificates (routine & acceptance tests) need to be submitted along with the delivery of cables.

**7.0 DOCUMENT SUBMISSION MATRIX**

Document/Drawing submission shall be as per the matrix given below:

- a. All documents/drawings shall be provided in soft copy only via mail or in returnable Pen drives
- b. Language of the documents shall be English only.
- c. Document check sheet compliance shall be the first sheet for each submission stage i.e. Technical bid, Drawing Approval, Pre Dispatch, Pre closure

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

- d. No submission is acceptable without check list compliance.
- e. Deficient/ improper or incomplete document/ drawing submission shall be liable for rejection.
- f. Order of documents shall be strictly as per the check list.
- g. Any document not included in the below table but necessary for detailed engineering shall be deemed to be included in bidder's scope

<b>S No.</b>	<b>Detail of Document</b>	<b>Bid</b>	<b>Approval</b>	<b>Pre Dispatch</b>
1	Guaranteed Technical Particulars (GTP)	Required	Required	
2	Deviation Sheet, if any	Required	Required	
3	Detailed cross sectional drawing of cable	Required	Required	
4	Dimensional drawing of cable drum	Required	Required	
4	Type test reports of offered type and rating of cable	Required	Required	
5	BIS certificate	Required		
6	Complete cable catalogue	Required		
7	Make of Raw Materials	Required	Required	
8	Cable de-rating factors	Required	Required	
9	Armour coverage calculation		Required	
10	Inspection test reports and Routine Test Certificates carried out in manufacturer's works			Required
12	Test certificates of all raw materials			Required
13	Calibration test reports of instruments			Required

**8.0 PROGRESS REPORTING**

8.1	Outline Document	To be submitted for purchaser approval for outline of Production-inspection, testing-inspection, packing, dispatch, documentation programme.
8.2	Detailed Progress Report	To be submitted to purchaser once a month containing a) Progress on material procurement b) Progress on fabrication (As applicable) c) Progress on assembly (As applicable) d) Progress on internal stage inspection e) Reason for any delay in total programme f) Details of test failures if any in manufacturing stages. g) Progress on final box up constraints/forward path.

**9.0 DEVIATION**

- a) Deviations from this specification shall be listed separately by bidder clause wise (format given below) along with optional offer and has to submit the list along with bid/quotation. BSES will review the deviations and if BSES is agreed with the deviation, seller has to take written confirmation from BSES on deviation during tender evaluation.
- b) In the absence of any separate list of deviations from the bidders with bid as well as written confirmation from BSES on deviations, it will be assumed by the Buyer that the Seller complies with the Specification fully.
- c) Any deviations mentioned in any other submitted bid documents (i.e.in filled GTP, Catalog, BSES old approval, buyer's/seller's standards etc) by seller without separate deviation sheets will not consider as a deviation from this tech spec at any stage of contract.

Deviation sheet format

Sl. No.	Document Name	Clause No.	Deviation	Reason	Merit to BSES

**TECHNICAL SPECIFICATION OF LT POWER CABLE****10.0 Annexure -A****GUARANTEED TECHNICAL PARTICULARS (Multi-core)****(Standard Cable sizes are 2cx10, 2cx25, 4cx25, 4cx50, 4C X 95, 4cx150, 4cx300, 4cx400)****For each size /rating separate GTP need to be furnished**

<b>Sr. No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
	Manufacture Contact Person & Number		
	Purchase Req. No.	.....	
	Guarantee Period: ( Min )	60 Months (from date of commissioning) / 66 months (from date of receipt at purchaser's store) whichever is earlier	
	Applicable IS / IEC Standard followed by vendor	As mentioned in the clause no – 2.0	
1	Make	...	
2	Type (as required by purchaser)		
A	For 2CX10Sqmm	A2XWY	
B	For Sizes above 10 mm <sup>2</sup>	A2XFY	
3	Voltage Grade (kV)	1.1	
4	Maximum Conductor temperature		
A	Continuous	90°C	
B	Short time	250°C	
5	Conductor		
A	Material and Grade	As per Cl.3.1	
B	Make of Al	Ref Annexure D	
C	Size (mm <sup>2</sup> )	..... mm <sup>2</sup>	
D	Min no. of wires in each conductor (Nos.)	As per Manufacturer Standard	
E	Min Dia. of wires in each conductor before compaction (mm)	As per Manufacturer Standard	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>Sr. No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
F	Shape of Conductor	As per Cl.3.1 (e)	
G	Diameter over conductor (mm)	.....	
H	Maximum Conductor resistance at 20 ° C(Ohm/Km)	As per Table 2 of IS 8130	
6	Insulation		
A	Insulation Material	As per Cl. 3.2	
B	Nominal thickness (mm)	As per Table 3 of IS 7098 Part-1	
C	Diameter over Insulation (mm) Approx.	.....	
D	Make of insulation compound	Ref: Annexure D	
7	Inner Sheath		
A	Material and Type	As per Cl. 3.4	
B	Minimum thickness	As per Table 5 of IS 7098 Part-1	
C	Approx. dia. Over sheath (mm)	.....	
8	Galvanized Steel Armour	as per purchaser's site - specific condition	
A	Material		
a)	For 2CX10 mm <sup>2</sup>	G.I. Wire	
(i)	Wire Dia. (mm)	1.4+/-0.040	
(ii)	No. of wires	As per Manufacturer Standard	
b)	For sizes above 10 mm <sup>2</sup>	G.I. Strip	
(i)	Strip size ( Width and Thickness)	4x0.8 (Zero negative tolerance for thickness)	
(ii)	No. of Strips	As per Manufacturer Standard	
B	Area covered by Armour	Min 90% and calculations shall be strictly as per Annexure-D	
C	Dia. over Armour – Approx.(mm)	.....	



**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>Sr. No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
9	Outer Sheath (FRLS)		
A	Material and Type	As per Cl. 3.6	
B	Minimum Thickness	As per Table 8 of IS 7098 Part-1	
C	Colour	Orange	
D	Embossing Details	As per Cl.3.6 (e)	
10	Approx. overall dia. (mm)	.....	
11	Overall order tolerance	- 2 % for the total cable length for the entire order	
12	Cable Drum		
A	Type of Drum	Wooden	
B	Drum Length & tolerance	As per Spec. Cl. 4.3 & 4.4	
C	Marking on Drum	As per Spec. Cl. 4.7	
D	Drums provide with MS Spindle plate & nut bolts arrangement (as per IS:10418)	Required	
13	End Cap	Required	
14	Weights	.....	
a)	Net Weight of cable ( Kg/Km. ) – Approx		
b)	Weight of empty drum	Kg	
c)	Weight of cable with drum	Kg	
15	Continuous current rating for standard I.S condition laid direct		
a)	In ground 30° C	Amps	
b)	In duct 30° C	Amps	
c)	In Air 40° C	Amps	
16	Short circuit current for 1 sec of Conductor (kAmp)	.....	
17	Electrical Parameters at Maximum operating temperature:		
A	AC Resistance	Ohm/Km	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>Sr. No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
B	Reactance at 50 C/s	Ohm/Km	
C	Impedance	Ohm/Km	
D	Capacitance	Micro farad / Km	
18	Recommended minimum bending radius	..... x O/D	
19	De-rating factor for following Ambient temperature in	Ground / Air	
a)	At 30° C		
b)	At 35° C		
c)	At 40° C		
d)	At 45° C		
e)	At 50° C		
20	Group factor for following Nos. of cables laid	Touching / Trefoil	
a)	3 Nos.		
b)	4 Nos.		
c)	5 Nos.		
d)	6 Nos.		
21	Process of Cross linking of Polyethylene	Dry/ Sioplas Cure	
22	Type test	Is copy of latest valid TTR for respective Sizes enclosed? Yes /No	
23	FRLS Properties	As per IS 1554, Part-1	
	Oxygen Index	As per IS 1554, Part	
	Temperature Index	As per IS 1554, Part	
	Max Acid Gas Generation	As per IS 1554, Part	
	Light Transmission / Smoke Density	As per IS 1554, Part	

**11.0 ANNEXTURE- B****GUARANTEED TECHNICAL PARTICULARS (Single Core)****(Separate GTP needs to be furnished for 25, 95, 300, 500, 630 & 1000 mm<sup>2</sup> cables)**

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>S.No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
	Manufacture Contact Person & Number		
	Purchase Req. No.	.....	
	Guarantee Period: ( Min )	60 Months (from date of commissioning) / 66 months (from date of receipt at purchaser's store) whichever is earlier	
	Applicable IS / IEC Standard followed by Vendor	As mentioned in the clause no-2.0	
1	Make	.....	
2	Type	A2XY (Un-armoured)	
3	Voltage Grade (kV)	1.1kV	
4	Maximum Conductor temperature		
A	Continuous	90°C	
B	Short time	250°C	
5	Conductor		
A	Material and Grade	As per Cl. 3.1	
B	Size (mm <sup>2</sup> )	.....mm <sup>2</sup>	
C	Min no. of wires in each conductor (Nos.)	As per Manufacturer Standard	
D	Min Dia. of wires in each conductor before compaction (mm)	As per Manufacturer Standard	
E	Shape of conductor	Compacted Circular	
F	Diameter over conductor (mm)	.....	
G	Maximum Conductor resistance at 20 ° C(Ohm/Km)	As per Table 2 of IS 8130	
H	Make of Al	Ref Annexure D	
6	Insulation	As per Table 3 of IS7098 Part-1	
A	Insulation Material	As per Cl. 3.2	

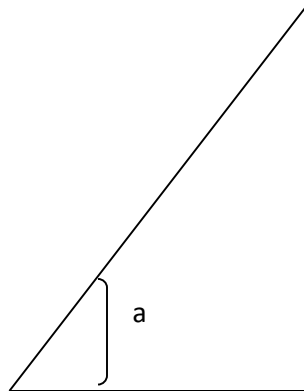
**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>S.No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
B	Nominal thickness (mm)		
(i)	For 1Cx300 mm <sup>2</sup>	1.8 mm	
(ii)	For 1Cx500 mm <sup>2</sup>	2.2 mm	
(iii)	For 1Cx630 mm <sup>2</sup>	2.4 mm	
iv)	For 1Cx1000 mm <sup>2</sup>	2.8 mm	
C	Diameter over Insulation (mm) Approx.	.....	
D	Make of insulation compound	Ref: Annexure D	
7	Inner Sheath	Not applicable	
8	Armour	Not applicable	
9	FRLS Outer Sheath		
A	Material and Type	As per Cl. 3.6	
B	Minimum Thickness	As per Table 8 of IS 7098 Part-1	
C	Colour	Orange	
D	Embossing Details	As per Cl.3.6 (e)	
10	Approx. overall dia. (mm)	.....	
11	Overall order tolerance	-2 % for the total cable length for the entire order	
12	Cable Drum		
A	Type of Drum	Wooden	
B	Drum Length & tolerance	As per Spec. Cl. 4.3 & 4.4	
C	Marking on Drum	As per Spec. Cl. 4.7	
D	Drums provide with MS Spindle plate & nut bolts arrangement (as per IS:10418)	Required	
13	End Cap	Required	
14	Weights	.....	
a)	Net Weight of cable ( Kg/Km. ) – Approx		
b)	Weight of empty drum	Kg	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

<b>S.No.</b>	<b>Description</b>	<b>Buyer's Requirement</b>	<b>Seller's data</b>
c)	Weight of cable with drum	Kg	
15	Continuous current rating for standard I.S condition laid direct		
a)	In ground 30° C	Amps	
b)	In duct 30° C	Amps	
c)	In Air 40° C	Amps	
16	Short circuit current for 1 sec of Conductor (kAmp)	.....	
17	Electrical Parameters at Maximum operating temperature:		
A	AC Resistance	Ohm/Km	
B	Reactance at 50 C/s	Ohm/Km	
C	Impedance	Ohm/Km	
D	Capacitance	Micro farad / Km	
18	Recommended minimum bending radius	..... x O/D	
19	Derating factor for following Ambient temperature in	Ground / Air	
a)	At 30° C		
b)	At 35° C		
c)	At 40° C		
d)	At 45° C		
e)	At 50° C		
20	Group factor for following Nos. of cables laid	Touching / Trefoil	
a)	3 Nos.		
b)	4 Nos.		
c)	5 Nos.		
d)	6 Nos.		
21	Process of Cross linking of Polyethylene	Dry/ Sioplas Cure	
22	Type test	Is copy of latest valid TTR for respective Sizes enclosed?	

S.No.	Description	Buyer's Requirement	Seller's data
		Yes /No	
23	FRLS Properties		
	Oxygen Index	As per IS 1554, Part	
	Temperature Index	As per IS 1554, Part	
	Max Acid Gas Generation	As per IS 1554, Part	
	Light Transmission / Smoke Density	As per IS 1554, Part	

**12.0 ANNEXTURE – C****ARMOUR COVERAGE PERCENTAGE**

$$\text{Percent coverage} = \frac{N \times d}{W} \times 100$$

Where,

N = number of parallel wires / Strips

d = diameter of wire / width of formed wires

$W = \pi \times D \times \cos a$ ,

D = diameter under armour

a = angle between armouring wire / formed wires and axis of cable

$\tan a = \pi \times D/C$ , and

C = lay length of armouring wires / formed wires.

Min 90% armour coverage shall be provided both in case of wires and strips.

The gap between armour wires / formed wires shall not exceed one armour wire / Formed wire space and there shall be no cross over / over-riding of armour wire / Formed wire so, the minimum area of coverage of armouring shall be 90%.

**13.0 ANNEXTURE – D****LIST OF SUB-VENDORS**

<b>Sr. No.</b>	<b>Description of Material</b>	<b>Sub-Vendors</b>
1	E.C Grade Aluminium Rod	Bharat Aluminium Co. Ltd. (BALCO) Hindustan Aluminium Co. Ltd. (HINDALCO) National Aluminium Co. Ltd. (NALCO)
2	XLPE Compound	Kkalpana Industries Ltd. KLJ Polymers and Chemicals Ltd. Dow Chemical, U.S.A Borealis, Sweden Hanwha, Seoul, South Korea
3	PVC Compound	Kkalpana Industries Ltd. KLJ Polymers and Chemicals Ltd. Universal SCJ Plastic Sriram Polytech Shri Ram Vinyl, Kota
4	GI Strip	Tata Balaji Systematic Mica Wires Pvt Ltd. Bansal Industries


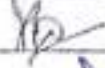
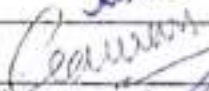
# BSES

## TECHNICAL SPECIFICATION

FOR

## FRLS CONTROL CABLE

SPECIFICATION NO. -- BSES-TS-57-CCAB-R0

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**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE**

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**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****1.0 SCOPE**

The scope of supply includes Design, Manufacture, Testing at manufacturer's works before dispatch, packing, delivery including unloading and stacking at site/store of Control Cable complete with all accessories.

**2.0 STANDARDS & CODES**

Materials, equipments and methods used in the manufacture of Cable shall conform to the latest edition of following:

<b>S No.</b>	<b>STANDARD</b>	<b>DESCRIPTION</b>
2.1	IS- 1554 Part-1	PVC insulated Cables
2.2	IS- 5831 : 1984	PVC insulation & sheath of electric cables.
2.3	IS- 10810 : 1984	Methods of test for cables.
2.4	IS- 8130 : 1984	Conductors for insulated electric cables and flexible cords.
2.5	IS- 3961 Part 2	Recommended current ratings for PVC insulated and PVC sheathed heavy duty Cables
2.6	IS- 3975 : 1999	Mild steel wires, formed wires and tapes for armouring of cables.
2.7	IS- 10418 : 1982	Drums for Electric Cables
2.8	IEC 60228 Ed.3.0 b	Conductors of insulated cables.
2.9	IEC 60332-3-21 Ed.1.0 b	Tests on electric cables under fire conditions. Part 3-21. Tests on bunched wires or cables.
2.10	IEC 60502-1 Ed. 2.1 b	Power cables with extruded insulation and their accessories for rated voltage from 1kV upto 30kV –Part 1: cables for rated voltages of 1kV and 3kV
2.11	IEC 60811	Common test methods for insulating and sheathing materials of electric cables.
2.12	IEC 60885 Ed.1.0 b	Electric test methods for electric cables.
2.13	IEC 60227	PVC insulated cables of rated voltages up to and including 450/750 V.
2.14	IEC 60028 Ed. 2.0 b	International Standard of Resistance for Copper
2.15	ASTMD 2843	Standard Test Method for density of Smoke from the burning or decomposition of cables
2.16	ASTM 2863	Standard Test Method for measuring of minimum oxygen concentration
2.17	IEC 60754-1	Test on gases evolved during combustion of materials for cables. Part 1 – Determination of the Halogen Acid gas Content

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****3.0 SERVICE CONDITIONS**

Control Cables to be supplied against this specification shall be suitable for satisfactory operation under the following conditions-

3.1	Average grade atmosphere	Heavily polluted, Dry
3.2	Maximum altitude above sea level	1000M
3.3	Relative Humidity	100%
3.4	Ambient air temperature	Highest 50 Deg C Average 40 Deg C Minimum 0 Deg C
3.5	Operating temperature	0 Deg C - 50 Deg C
3.6	Rainfall	750mm concentrated in four months

**4.0 DESIGN FEATURES**

(Refer Annexure – “A”)

<b>S No.</b>	<b>Parameters</b>	<b>Technical Requirements</b>
4.1	Cable construction Features	Size & dimensions of each item mentioned under this clause shall be followed as detailed out in GTP, refer Annexure A
4.2	Conductor	<ul style="list-style-type: none"><li>Stranded, plain copper, circular</li><li>Shall be made from high conductivity copper rods</li></ul>
4.3	Insulation	Extruded PVC Insulation Type A as per IS 5831
4.4	Core Identification	As per IS 1554 Part 1
4.5	Inner Sheath	Extruded Inner Sheath of Black PVC type ST-2 as per IS 5831
4.6	Armour	<ul style="list-style-type: none"><li>As per Clause 13.2 of IS 1554 Part-1: Galvanized steel round wire armour.</li><li>Minimum area of coverage of armouring shall be not less than 90 %. ( refer Annex C of IS 1554-part 1 for % calculation)</li></ul>

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE**

<b>S No.</b>	<b>Parameters</b>	<b>Technical Requirements</b>
4.7	Outer Sheath	<ul style="list-style-type: none"><li>a) Extruded outer sheath of PVC type ST-2 as per IS 5831 having FRLS properties</li><li>b) Color : Black</li><li>c) The Outer Sheath shall be embossed with:<ul style="list-style-type: none"><li>i. The voltage designation</li><li>ii. Type of construction / cable code (for e.g. AYWY)</li><li>iii. Manufacturers Name or Trade mark</li><li>iv. Number of Cores and nominal cross sectional area of conductors</li><li>v. The drum progressive length of cable and individual drum number at every meter. (By Printing)</li><li>vi. Name of buyer i.e. BSES</li><li>vii. Month &amp; Year of Manufacturing</li><li>viii. P.O. No. and P.O. Date</li></ul></li></ul>
4.8	FRLS Properties	<ul style="list-style-type: none"><li>a) Oxygen Index : Not less than 29% as per ASTM 2863</li><li>b) Temperature Index: 250°C at Oxygen Index 21 (when tested as per ASTM D 2863)</li><li>c) Max Acid Gas Generation – Not more than 20% as per IEC -60754-1</li><li>d) Light Transmission - Minimum 40% when tested as per ASTM D 2843 (Smoke Density rating shall be max 60%)</li><li>e) Flammability Test – As per IEC 60332-III, Cat – B, IEC 60332- I, IS- 10810 – Part 53, IS:10810 – Part 61 &amp; 62 (Category A)</li></ul>
4.9	Sealing of cable end	Both ends of the cable shall be sealed with PVC Cap.
4.10	Drum length & tolerance	500 mtr (+/- 5%)
4.11	Overall tolerance in cable length	- 2 %
4.12	Short length of cables	<ul style="list-style-type: none"><li>a) Minimum acceptable short length shall be above 100 meters. Manufacturer shall be required to take prior approval from engineering for any short length supply.</li><li>b) Manufacturer shall not be allowed to put two cable pieces of different short lengths in same cable drum.</li><li>c) Only 1% of the total ordered quantity.</li></ul>

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****5.0 QUALITY ASSURANCE PLAN, INSPECTION AND TESTING**

<b>S No.</b>	<b>Parameters</b>	<b>Technical Requirements</b>
5.1	Quality Assurance Plan	QAP Shall be submitted by vendor for approval. Inspection and testing of the material shall be carried out accordingly.
5.2	Type test	Cables must be of type tested as per relevant IS/IEC/ASTM. Type test conducted either from CPRI/ERDA/NABL third party accredited lab will be treated as valid. Type test reports shall be submitted for the type, size & rating of cable offered along with bid.
5.3	Routine test	Each drum length of cable shall be subjected to the routine tests as mentioned in IS 1554 part -1
5.4	Acceptance Tests	The sampling & acceptance tests Shall be conducted, as per IS 1554 Part-1 and approved QA plan, for each lot of cable during the inspection of lot at manufacturer's works.
5.5	Inspection	a) The buyer reserves the right to inspect cables at the Seller's works at any time prior dispatch, to verify compliance with the specifications.  b) In-process and final inspection call intimation shall be given in 15 days advance to purchaser.  c) In the event of any discrepancy in the test reports i.e. test reports not acceptable or any type tests (including special /additional tests, if any) not carried out, same shall be carried out without any cost implication to BSES before dispatch of cable.
5.6	Test certificates	Test certificates (routine and acceptance) shall be submitted along with the dispatch documents.

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****6.0 PACKING, SHIPPING, HANDLING & SITE SUPPORT**

6.1	Packing	The cable shall be wound on wooden drums (with anti termite treatment and M.S. spindle plate with nut-bolts). Cable should be packed conforming to Indian / international standards. The drum shall be fully enclosed by suitable packing preferably PP sheeting.
6.2	Drum identification label	The following information shall be marked on the drum: a) Drum identification number b) Trade name or trade mark; if any c) Name of manufacturer d) Name of buyer i.e. BSES e) Cable voltage grade f) Cable code (e.g. YWY) g) Number of cores and cross sectional area h) Purchase order number with SAP item code i) Year and month of manufacturing j) Direction of rotation of drum (an arrow) k) Net weight of cable in drum and gross weight of cable with drum l) Batch no or Lot no. m) Cable length initial reading & end reading shall be marked on drum. Cable starting end shall be taken out from winding to read this drum reading with proper sealing to protect against external damage.
6.3	Shipping	The seller shall give complete shipping information concerning the gross weight, size of each packing.
6.4	Handling & Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet/manual needs to be furnished before commencement of supply.
6.5	Transit damage	The seller shall be responsible for any transit damage due to improper packing.

**7.0 DEVIATIONS**

7.1	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification.
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**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****8.0 DOCUMENT SUBMISSION MATRIX**

Document/Drawing submission shall be as per the matrix given below. All documents/drawings shall be provided in soft copy only in returnable Pen drives. Language of the documents shall be English only. Incomplete submission shall be liable for rejection.

<b>S No.</b>	<b>Description</b>	<b>Bid</b>	<b>Approval</b>	<b>Pre Dispatch</b>
8.1	Guaranteed Technical Particulars (GTP)	required	required	
8.2	Deviation Sheet, if any	required	required	
8.3	Detailed cross sectional drawing of cable	required	required	
8.4	Dimensional drawing of Cable Drum		required	
8.5	Type test reports for the offered type and rating of cable	required	required	
8.6	BIS Certificate	required		
8.7	Make of Raw Materials	required	required	
8.8	Cable de-rating factors	required	required	
8.9	Manufacturer's Quality Assurance Plan		required	
8.10	Detailed installation & commissioning instructions		required	
8.11	Test certificates of all raw materials			required
8.12	Inspection and routine test reports, carried out in manufacturer's works			required

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE****Annexure – A: Guaranteed Technical Particulars (Data by Supplier)**

(Standard Cable sizes are 2Cx2.5, 4Cx2.5, 6C X 2.5, 8Cx2.5, 10Cx2.5, 12C X 2.5 mm<sup>2</sup>)

**For each size separate GTP need to be furnished**

**\*For any size other than standard sizes mentioned, GTP should be as per IS or requirement whichever applicable**

<b>Sr.</b>	<b>Description</b>	<b>Buyer's requirement</b>	<b>Vendor's Data</b>
	Purchase Req. No.	....	
	Guarantee Period: 5 Years	60/66 Months	
1.0	Make	To be specified by vendor	
2.0	Type ( AS PER IS 1554 part -1 )	YWY	
3.0	Voltage Grade (KV)	1.1	
4.0	Maximum Conductor temperature		
a)	Continuous (° C)	70°C	
b)	Short time (° C)	160°C	
5.0	Conductor		
a)	Size (mm <sup>2</sup> )	2.5	
b)	No. of wires in each conductor	As per Manufacturer standard	
c)	Dia. of wires in each conductor before compaction (mm)	As per Manufacturer standard	
d)	Shape of Conductor	As per Clause 4.2 of specification	
e)	Diameter over conductor mm	To be specified by vendor	
f)	Maximum Conductor resistance at 20 ° C (Ohm/Km)	As per Table 2 of IS 8130	
6.0	Insulation	As per Table 1 of IS:5831 – 1984	
a)	Nominal thickness (mm)	As per Clause 4.3 of specification & Table 2 of IS 1554( Part-1)	
b)	Minimum thickness (mm)		
c)	Core Identification	As per IS 1554 Part 1	
d)	Approx. dia. over Insulation (mm)	To be specified by	



**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE**

<b>Sr.</b>	<b>Description</b>	<b>Buyer's requirement</b>	<b>Vendor's Data</b>
		vendor	
7.0	Inner Sheath	As per Table 2 of IS:5831 – 1984	
a)	Minimum thickness (mm)	As per Table 4 of IS 1554( Part-1)	
b)	Approx. dia. Over sheath (mm)	To be specified by vendor	
8.0	Galvanized Steel Armour	As per IS 1554-part 1	
a)	Number of armour wire	As per Manufacturer Std.	
b)	Nominal dia. of Round Wire	As per Table 5 of IS 1554( Part-1)	
c)	Dia. over armour – approx.	To be specified by vendor	
d)	Lay Ratio	To be specified by vendor	
e)	Confirm minimum 90% coverage (submit calculation)		
9.0	Outer Sheath (FRLS)	As per Table 2 of IS:5831 – 1984	
a)	Thickness (min)	As per Table 7 of IS 1554( Part-1)	
b)	Color	Black	
10.0	Approx. overall dia. (mm)	To be specified by vendor	
11.0	Drum length & tolerance	As per clause 4.10 of specification	
12.0	End Cap	Required	
13.0	Drums provide with MS Spindle plate & Nut bolts arrangement	Required	
14.0	Net Weight of cable ( Kg/Km. ) – approx.	To be specified by vendor	

**TECHNICAL SPECIFICATION FOR FRLS CONTROL CABLE**

<b>Sr.</b>	<b>Description</b>	<b>Buyer's requirement</b>	<b>Vendor's Data</b>
15.0	Continuous current rating for standard I.S. condition laid Direct		
a)	In ground 30° C Amps	To be specified by vendor	
b)	In duct 30° C Amps	To be specified by vendor	
c)	In Air 40° C Amps	To be specified by vendor	
16.0	Short circuit current for 1 sec of conductor. (KAmp)	To be specified by vendor	
17.0	Electrical Parameters at Maximum Operating temperature:		
a)	Resistance (Ohm/Km ) (AC Resistance)	To be specified by vendor	
b)	Reactance at 50 C/s ( Ohm/Km )	To be specified by vendor	
c)	Impedance ( Ohm/Km )	To be specified by vendor	
d)	Capacitance (Micro farad / KM)	To be specified by vendor	
18.0	Recommended minimum bending radius	.... x O/D	
19.0	FRLS Properties		
a)	Oxygen Index	To be specified by vendor	
b)	Temperature Index	To be specified by vendor	
c)	Max Acid Gas Generation	To be specified by vendor	
d)	Light Transmission / Smoke Density	To be specified by vendor	



**Technical Specification**  
**of**  
**Illumination and Lighting System**  
**Specification no – BSES-TS-98-ILS-R0**

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Prepared by	Bhanu Gehlot	
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**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM****1. SCOPE**

The specification covers the design, engineering, manufacture, assembly and testing at manufacturer's work, supply and installation of Illumination system for substation including normal distribution pillars, normal lighting board, emergency distribution pillar, emergency lighting board, Junction boxes, Illumination lamps with required lux level.

**2. STANDARDS AND CODES**

<b>Standard Code</b>	<b>Standard Description</b>
IS 16101 : 2012	General Lighting -LEDs and LED modules – Terms and Definitions
IS16102(Part 1) 2012	Self-Ballasted LED Lamps for General Lighting Services, Part 1 Safety Requirements
IS16102(Part 2) 2012	Self-Ballasted LED Lamps for General Lighting Services, Part 2 Performance Requirements
IS16103(Part 1) 2012	Led Modules for General Lighting, Part 1 Safety Requirements
IS16103(Part 2) 2012	Led Modules for General Lighting, Part 2 Performance Requirements
IS15885(Part2/Sec13)	Safety of Lamp Control Gear , Part 2 Particular Requirements , Section 13 dc. or ac. Supplied Electronic Control gear for Led Modules
IS16104 : 2012	d.c. or a.c. Supplied Electronic Control Gear for LED Modules - Performance Requirements
IS16105 : 2012	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
IS16106 : 2012	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products
IS 16107(Part 1)2012	Luminaires Performance ,Part 1 General Requirements
IS 16107(Part 2)2012	Luminaires Performance, Part 2 Particular Requirements ,Section 1 LED Luminaire
IS 16108 : 2012	Photo biological Safety of Lamps and Lamp Systems
IS 10322 : 2012	Luminaires: Part 5 Particular requirements, Section 3 Luminaires for road and street lighting
IS 5	Colours for Ready Mixed Paints and Enamels
IS 613	Copper Rods and Bars for electrical purposes
IS 694	PVC Insulated cables for working voltages up to and including 1100 V
IS 2551	Danger notice plates
IS 5082	Wrought Aluminium and Aluminium alloy bars, rods, tubes and sections for electrical purpose
IS 6665	Code of practice for industrial lighting
IS 13703	LV Fuses for voltage not exceeding 1000V ac or 1500V dc
IS 10118	Code of Practice for Selection, Installation and Maintenance of

**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM**

	Switchgear and Controlgear
<b>International Standard</b>	
IEC 62612	Self-ballasted LED lamps for general lighting services for voltage above 50 V — Performance requirements
IEC : 60598-2-3	Particular requirements - Luminaires for road and street lighting
IEC 62471	Photo biological safety of lamps and lamp systems
IEC 62778	Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires
IEC 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC 60439	Low Voltage Switchgear and Controlgear assemblies - Type tested and partially type tested assemblies
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60947-1	Low Voltage Switchgear and Controlgear - General Rules
IEC 60947-2	Low Voltage Switchgear and Controlgear - Circuit breakers
IEC 61643	Low-voltage surge protective devices

**3. ILLUMINATION SYSTEM**

3.1.	Lux level requirement	<p>3.1.1. The design of the illumination system shall ensure availability of the average illumination levels as specified below with the maximum possible uniformity in the entire substation. The illumination system shall consist of the normal lighting system and emergency lighting system. The minimum illumination levels shall be as specified below(Reference IS3646(Part II)).</p> <table style="margin-left: 20px;"> <tr> <td>3.1.1.1. Roads within substation</td> <td>:</td> <td>20 lux</td> </tr> <tr> <td>3.1.1.2. Boundary wall of the substation</td> <td>:</td> <td>10 lux</td> </tr> <tr> <td>3.1.1.3. Control room</td> <td>:</td> <td>300 lux</td> </tr> <tr> <td>3.1.1.4. Switchgear Room</td> <td>:</td> <td>200 lux</td> </tr> <tr> <td>3.1.1.5. Battery room</td> <td>:</td> <td>100 lux</td> </tr> <tr> <td>3.1.1.6. Stair case</td> <td>:</td> <td>100 lux</td> </tr> <tr> <td>3.1.1.7. Power Transformers</td> <td>:</td> <td>100 lux</td> </tr> <tr> <td>3.1.1.8. Cable cellar/ Indoor trench</td> <td>:</td> <td>70 lux</td> </tr> <tr> <td>3.1.1.9. Outdoor switchyard</td> <td>:</td> <td>70 lux</td> </tr> <tr> <td>3.1.1.10. APFC/ station trafo</td> <td>:</td> <td>70 lux</td> </tr> </table> <p>3.1.2. Contractor shall design the lighting system with the help of desired software. Owner shall verify the same post commissioning with lux meter to check the levels. In case desired lux levels are not met contractor has to install addition fitting in outdoor and indoor location as per requirement.</p> <p>3.1.3. Complete design calculation sheets for arriving at the number of luminaires required for the normal and emergency requirements shall be furnished by the bidder. Design calculation sheets for the selection of cables, MCB, HRC fuses, bus bars, etc. are also required to be furnished for Owner's approval.</p>	3.1.1.1. Roads within substation	:	20 lux	3.1.1.2. Boundary wall of the substation	:	10 lux	3.1.1.3. Control room	:	300 lux	3.1.1.4. Switchgear Room	:	200 lux	3.1.1.5. Battery room	:	100 lux	3.1.1.6. Stair case	:	100 lux	3.1.1.7. Power Transformers	:	100 lux	3.1.1.8. Cable cellar/ Indoor trench	:	70 lux	3.1.1.9. Outdoor switchyard	:	70 lux	3.1.1.10. APFC/ station trafo	:	70 lux
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**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM**

3.2.	Illumination circuit	<p>3.2.1. The illumination system load and welding load in the substation area shall be supplied from 415/230 volt ACDBs to be provided in the substation control room. Requisite numbers of 3-phase, 4-wire, cable circuits for illumination system and welding socket outlets shall be extended from the above board. The laying of cables from the Board to the illumination system/welding socket outlets and their installation are included in the Bidder's scope.</p> <p>3.2.2. Each outgoing cable circuit for illumination loads from the 415 volt switchboard shall terminate in the respective outdoor pillar boxes located in the substation. Outgoing feeders from the illumination shall be taken to the various illumination points in the substation. Necessary fuses shall be provided near light fixtures in the substation.</p> <p>3.2.3. The emergency illumination load shall be supplied from the main emergency illumination board located in the control room. Necessary cable circuits with appropriate fuses shall be provided by the Contractor for the supply system for emergency illumination load of the substation.</p> <p>3.2.4. Emergency DC lighting system shall be provided in the substation wherever required. The emergency lighting shall be adequate for safe movement by the operating personnel in the substation in the event of failure of normal lighting system. Number of lights shall be decided at the time of detailed engineering. A total of minimum 12 no's individually controllable 18 watt LEDs shall be provided in the substation.</p> <p>3.2.5. 6 Nos. welding sockets to be provided, 4 Nos. in Outdoor Yard &amp; 2 Nos. in Control room building.</p> <p>3.2.6. Illumination to be provided inside the Indoor trenches as per required lux level.</p>
3.3.	Wiring	<p>3.3.1. All lighting fixtures and 5A convenience outlets shall be wired with 1.1 KV grade PVC insulated extra flexible, multistranded, copper conductor cables of size not less than 2.5 sq.mm.</p> <p>3.3.2. For 15A heavy-duty outlets copper conductor cables of size not less than 6 sq. mm shall be used.</p> <p>3.3.3. The wiring shall consist of phase, neutral and ground. For grounding the lighting fixtures/convenience outlets etc. Green CU wire of size 2.5 sqmm shall be used. The phase and neutral conductor shall be suitably colour coded. For DC black &amp; white wires to be used.</p> <p>3.3.4. Supply shall be looped between the lighting fixtures of the same circuit by using junction boxes. For this purpose one (1) 100 mm x 100 mm square junction box shall be provided for each lighting fixture. For recessed lighting fixtures, supply shall be extended from the junction boxes to the fixtures by means of flexible conduits. The conduits shall be of HMS (High mechanical stress) type and of minimum dia 25 MM. While for stem-mounted/wall-mounted lighting fixtures the junction box shall be</p>

**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM**

		<p>mounted below one of the mounting stems.</p> <p>3.3.5. For lighting branch circuits the nos. of lighting switches shall be decided keeping in mind the ease of control, as well as to limit the current to 2.5A per circuit.</p> <p>3.3.6. For convenience outlets, the bidder shall design the wiring scheme so as to limit 6 nos. of 5A outlets per branch circuit and two nos. of 15A outlets per branch circuit.</p> <p>3.3.7. All wiring materials such as terminals, crimping lugs, ferrules etc. shall also be provided by the Contractor.</p> <p>3.3.8. No section of the conduit shall be filled with more than 70% of its area. Any consumable material that is required for pulling the wires through conduit shall also be provided by the Contractor.</p> <p>3.3.9. Lighting fixtures coming in one area shall be evenly distributed between three phases so that tripping of one phase or two phases does not cause total loss of illumination in that area.</p>
3.4.	Required documents to be submitted	Complete manufacturer's literature/catalogues, performance curves, illumination distribution curves, G.A. drawings, specification sheets, etc. as relevant in respect of all materials/equipment to be supplied shall be submitted by the Contractor.
3.5.	Illumination system check after installation	After completion of installation of the illumination system in the substation, the actual illumination level at different locations shall be measured by the Contractor in the presence of Owner's authorised representative. If the average value of the measured illumination levels is found to fall short of the specified levels, the Contractor shall have to provide additional lighting fixtures so as to achieve the specified levels of illumination at no additional cost to the Owner. While measuring the illumination levels due allowance shall be made on account of maintenance factor. The specified lux levels shall be suitably increased to cover maintenance factor of 0.6 for outdoor areas.

**4. DISTRIBUTION PILLARS FOR NORMAL ILLUMINATION SYSTEM**

4.1.	Construction	<p>4.1.1. Distribution pillars of adequate dimensions shall be constructed from sheet steel having a thickness not less than 2 mm.</p> <p>4.1.2. The pillars shall be totally enclosed weather-proof, dustproof, vermin-proof, having hinged doors with locking arrangement and shall be capable of being mounted in the substation.</p> <p>4.1.3. The pillars suitable for cable entry at the bottom shall be designed for easy access of connections to terminals and inspection of equipment mounted therein.</p> <p>4.1.4. The degree of protection of the board shall be IP55.</p> <p>4.1.5. The enclosure shall be painted externally with Shade No., 692 of IS:5 and internally with brilliant white of semi-glossy finish of IS:5.</p> <p>4.1.6. Location of LDB, ELDB &amp; PDB to be finalized during</p>
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			detailed engineering.
4.2.	Configuration	4.2.1.	Each pillar shall accommodate the following:
		4.2.2.	One incoming, 4-pole (3 phase and neutral) isolating switch with MCB of appropriate current rating.
		4.2.3.	3-phase and neutral bus bars of appropriate current rating.
		4.2.4.	Single-pole earth leakage circuit breakers of suitable current ratings on all outgoing circuits.
		4.2.5.	Neutral links for all outgoing circuits.
		4.2.6.	Cable lugs, compression type cable glands, name plates, circuit numbers, earthing lugs, etc. to make the pillar complete in all respects.
		4.2.7.	20% spare outlets shall be provided for outgoing feeders.
		4.2.8.	Three (3) indicating lamps with fuses to indicate that supply is 'ON'.

**5. LIGHTING DISTRIBUTION BOARDS**

5.1.	Construction	5.1.1.	Metal-clad enclosure with minimum 2 mm CRCA sheets for load-bearing members and 1.6 mm for non load-bearing members suitably reinforced with structural.
		5.1.2.	3-phase, 4-wire bus bar system with high conductivity aluminium busbars mounting on FRP insulators having anti-tractive property with minimum 25 mm phase-to-phase and minimum 19 mm phase-to-earth clearances. The busbars shall be uniform throughout the length of the LDB and busbar joints shall be silver plated and covered with shrouds.
		5.1.3.	All cables shall enter from the bottom.
		5.1.4.	The degree of protection for the LDB shall be IP-54.
		5.1.5.	The enclosure shall be painted externally with Shade No., 692 of IS:5 and internally with brilliant white of semi-glossy finish of IS:5.
5.2.	Configuration		Each LDB shall accommodate the following:
		5.2.1.	One incoming, 4-pole (3 phase and neutral) isolating switch with MCB of appropriate current rating.
		5.2.2.	3-phase and neutral bus bars of appropriate current rating.
		5.2.3.	4 Pole outgoing MCBs of appropriate rating
		5.2.4.	Cable lugs, compression type cable glands, name plates, circuit numbers, earthing lugs, etc. to make the pillar complete in all respects.
		5.2.5.	20% spare outlets shall be provided for outgoing feeders.
		5.2.6.	Three (3) Nos. indication lamps (Red, Yellow, Blue) shall be provided to indicate that the incoming supply is available. Similarly, 3 Nos. indication lamps shall be provided to indicate that the busbar is energised.
5.3.	Busbar	5.3.1.	The busbars shall be suitable for short-time current rating of 40KA for 1 Sec.

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		<p>5.3.2. The busbar temperature rise shall not exceed 35 Deg C over an ambient of 50 Deg C.</p> <p>5.3.3. The LDBs shall be provided with a continuous busbar of 25 x 6 sq.mm (electrolytic copper) with suitable hardware for connection to the main grounding grid</p>
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**6. MAIN EMERGENCY LIGHTING BOARD**

6.1.	Construction	<p>6.1.1. Metal-clad enclosure with minimum 2 mm CRCA sheets for load-bearing members and 1.6 mm for non load-bearing members suitably reinforced with structural.</p> <p>6.1.2. All cables shall enter from the bottom.</p> <p>6.1.3. The degree of protection for the LDB shall be IP-54.</p> <p>6.1.4. The enclosure shall be painted externally with Shade No., 692 to IS:5 and internally with brilliant white of semi-glossy finish to IS:5.</p>
6.2.	Configuration	<p>6.2.1. Each Board shall accommodate the followings:</p> <p>6.2.2. Automatic changeover contactor.</p> <p>6.2.3. Voltage sensing relays.</p> <p>6.2.4. Time delay relay.</p> <p>6.2.5. Bus Bars.</p> <p>6.2.6. Two pole MCBs of adequate ratings for incoming and outgoing feeders.</p> <p>6.2.7. Test switch, push button type.</p> <p>6.2.8. Indicating lamps, ac - Green, dc - Red.</p> <p>6.2.9. Terminals for remote indication</p> <p>6.2.10. Cable lugs, compression type cable glands, name-plates, circuit numbers, earthing lugs and remote indication wiring upto substation 415V a.c. control board, to make the board complete in all respects.</p>
6.3.	Changeover facility	<p>The main emergency lighting board shall have an automatic changeover switch to energise the dc lighting system in the event of AC power failure. It shall have voltage-sensing relays to perform the changeover automatically when AC voltage of any one phase falls below 60 percent of 240 volts and continues at that low level for more than 10 seconds. These shall changeover from DC to AC again when 70 percent of 240 volt is restored and this continues for 10 seconds.</p>
6.4.	Emergency Lighting Pillar	<p>Local Emergency Lighting Pillar shall be identical in details to Lighting Distribution Pillar specified in clause 4 except that it shall have two pole isolating switch fuse unit on the incoming side and only two busbars and shall be without neutral links.</p>

**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM****7. LUMINAIRES**

7.1.	Luminaires type	Luminaires for use in normal and emergency illumination systems in the substation shall be suitable for LED lamps. All the luminaires shall be supplied complete with all accessories and lamps. The LED lamps ratings shall be adequate to achieve the required Lux level and calculation for number of luminaires shall be in the bidder's scope. Minimum rating shall be as follows -  7.1.1. Outdoor –90W minimum 7.1.2. Indoor –36W minimum
7.2.	Flood lights	The flood light luminaires in the substation shall be fixed at suitable height on the substation structures/ building, so as to provide the specified average illumination in the substation area without causing any glare to the operational/ maintenance staff working in the substation. While fixing the luminaires it shall be ensured that the stipulated electrical clearances are not violated. The Contractor shall supply and install suitable type of non-metallic street light poles or octagonal galvanized poles required for installing the fittings for illuminating the roads, fence boundary wall etc.
7.3.	Reliability	Substation lighting circuits shall be divided into two or three sections and provided with time switches of suitable ratings.
7.4.	Design features for Outdoor Luminaires	
7.5.	Fixture	7.5.1. The luminaires housing shall be either extruded or pressure die casted aluminium of minimum 1.6 mm thickness. Body must be Corrosion Resistant Powder Coated and UV resistant. 7.5.2. The entire housing shall be dust and waterproof having Ingress protection of housing as IP65 or above as per IEC 60529. 7.5.3. Luminaire should be covered with suitable Glass or diffuser with high Transitivity. All luminaires shall be supplied with either clear toughened glass or clear polycarbonate cover for better IP retention and higher life.
7.6.	LED	7.6.1. The luminous efficacy of LED luminaires shall be at least 85 lumen/watt. 7.6.2. LED module efficacy shall not be less than 90 percent of the rated LED module Efficacy. 7.6.3. Color Rendering Index (CRI) shall be at least 70 7.6.4. Color Temperature shall be 5500-6500K 7.6.5. Uniformity $E_{min}/E_{avg} > 0.4$ , $E_{min}/E_{max} > 0.33$
7.7.	LED Driver	LED driver shall have following features:  7.7.1. LED driver shall be applicable for Power supply 240V AC $\pm 10\%$ , at 50Hz $+3\%$ / $-5\%$ . 7.7.2. Output voltage of the driver shall be designed to meet the

**TECHNICAL SPECIFICATION OF ILLUMINATION AND LIGHTING SYSTEM**

		<p>Power Requirements of the system.</p> <p>7.7.3. Power factor of complete fitting shall be more than 0.90 at full load.</p> <p>7.7.4. Total Harmonic Distortion (THD) shall be &lt; 10 %</p>
7.8.	General Requirements	<p>7.8.1. The connecting wires used inside the Luminaire, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.</p> <p>7.8.2. The lumen maintenance of all the LED fixtures shall not be less than 70% after 50,000 hours.</p> <p>7.8.3. Built in protection features for Short circuit, Surges (at least upto 5kV), and overvoltage shall be provided.</p> <p>7.8.4. High /Low voltage cut-off shall be provided.</p> <p>7.8.5. The whole luminaire shall be eco-friendly green technology based i.e. mercury free.</p> <p>7.8.6. No UV and IR radiations shall be produced.</p> <p>7.8.7. Access of driver for maintenance shall be provided at the top/side of the luminaire fixture.</p> <p>7.8.8. All fasteners must be of stainless steel.</p>

**8. JUNCTION BOXES/WALL BOXES**

8.1.	Size	100 mm x 100 mm junction boxes and wall boxes of standard size shall be provided.
8.2.	Construction	Wall boxes and junction boxes shall be made of FRP with a thickness of 2.0mm. Necessary conduit termination fittings such as bushings, locknuts etc. also be provided.

**9. AUTOMATIC LIGHTING CONTROLLER**

9.1.	Size	Contractor shall provide microprocessor based automatic lighting controller for controlling switching arrangement of indoor and outdoor lighting. The controller shall have provision of setting 52 week ON / OFF time as per astronomical clock or as per user requirement. All abnormal events shall be recorded in the controller. Secure / Genus or equivalent are approved makes.
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**10. SOCKETS & SWITCHES**

10.1.	Indoor	All sockets and switches shall be modular and universal type suitable for 5/15A
10.2.	Outdoor	Two nos transformer oil filtration sockets shall be provided, one at each transformer bay. These sockets shall be three phase industrial type and rated for 100A.

**11. NAMEPLATE & MARKING**

11.1.	Name plate details of LED housing	Followings shall be clearly engraved/embossed on the die cast housing of LED: Rated voltage or voltage range (marked 'V' or 'Volt');  11.1.1. Rated current (marked 'A' or 'Ampere'); 11.1.2. Rated wattage (marked 'W' or 'Watts'); 11.1.3. Rated frequency (marked in 'Hz') 11.1.4. Rated lumen 11.1.5. Indian/International Standards to which it is manufactured 11.1.6. Month and year manufacture 11.1.7. Customer Name - BSES Yamuna / Rajdhani Power Ltd 11.1.8. Fitting serial number 11.1.9. PO no and date 11.1.10. Guarantee period
11.2.	Panel nameplate and marking details	
11.2.1.	Panel nameplate	Panel shall have a nameplate clearly indicating the following:  11.2.1.1. Panel Serial No.- 11.2.1.2. Customer Name - BSES Yamuna/Rajdhani Power Ltd 11.2.1.3. PO No. & date - 11.2.1.4. Panel Name - 11.2.1.5. Current rating - 11.2.1.6. Guarantee period -
11.2.2.	Feeder nameplate	Large and bold name plate carrying the feeder identification shall be provided on the top of each module.
11.2.3.	Danger plate	Panel shall have a danger plate of anodized Aluminium clearly indicating the danger logo and voltage details.
11.2.4.	Material	Anodized Aluminium 16SWG. Nameplates shall be satin silver in colour with black letters engraved on them. Stickers are not allowed.
11.2.5.	Fixing	All nameplates shall be riveted to the panels at all four corners. Bolting/screwing is not acceptable.

**12. APPROVED MAKE OF COMPONENTS**

12.1.	Relays	ABB/Jyoti/Omran
12.2.	HRC Fuse Links	GE/ Siemens/ L&T
12.3.	AC Contractors/ DC contactor	L&T/Siemens/Telemecanique/GE/ABB

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12.4.	Terminals	Connectwell/Elmex/Wago/Phoenix
12.5.	Push buttons / Actuator	L&T/Siemens/Vaishno/Schneider
12.6.	MCB	Legrand/Hager/Schneider/ABB
12.7.	LED	NICHIA/ OSRAM/ CREE/ PHILIPS//EDISON
12.8.	Luminaire fittings	GE/Philips/Crompton/Bajaj
12.9.	Indicating lamps	Vaishno/Binay/Teknic/Siemens/Mimic/C&S

**13. INSPECTION & TESTING**

13.1.	Type test	All Equipment should be of type tested quality only, type test certificate to be submitted along with offer. If the manufacturer's lab is accredited by govt. / authorized body then it shall be acceptable for type testing.
13.2.	Acceptance & Routine tests	As per relevant Indian standard

**14. DEVIATION**

14.1.	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.
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**TECHNICAL SPECIFICATION**  
**FOR**  
**11KV INDOOR SWITCHGEAR**  
**NEW GRIDS**

Specification no – SP-HTSWG-01-R2

Prepared by	Hemanshi Kaul	<i>H.Kaul</i>	Rev: 1
Reviewed by	Abhinav Srivastava	<i>Abhinav Srivastava</i>	Date: 11 Mar 2021
Approved by	K.Sheshadri	<i>K. Sheshadri</i> <i>11/03/21</i>	Page 1 of 17

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**RECORD OF REVISION**

<b>S. No</b>	<b>Revision no &amp; Date</b>	<b>Revision Clause No.</b>	<b>Revision Details</b>
1	R1 11.03.21	15.1.0 & 15.1.1	Sync check feature added in the relays.
2	R1 11.03.21	15.1.0 – 15.1.4	Relays shall be directional
3	R1 11.03.21	26.1.19	Vacuum interrupter make mentioned. Schneider, Siemens, BEL, BHEL, ABB, CGL & L&T.



**Volume – I Technical Specification for 11KV Indoor Switchgear**

**1.0 CODES & STANDARDS:**

Material, equipment and methods used in the manufacture of switchboard shall confirm to the latest edition of following standards: -

<b>Standard Name / No</b>	<b>Standard's Description</b>
Indian Electricity Rules 1956	Relevant safety regulation of CEA
Indian electricity act 1910	Latest edition
Switchgear and control gear	IEC: 60694, IEC: 60298, IEC: 62271-200, IEC: 60529. IS: 3427, IS 12729, IS 12063, IS:13947, IS: 9046
Circuit Breaker	IEC 62271-100, IS 13118, IS 2516
Isolators and earthing switches	IEC 62271-102
Current Transformers	IS:2705, IEC:60185
Voltage Transformer	IS:3156, IEC:60186
Indicating Instruments	IS:1248
Energy Meters	IS: 13010
Relays	IS 8686, IS 3231, IS 3842
Control switches and push buttons	IS 6875
HV Fuses	IS 9385
Arrangement of switchgear bus bars, main connections and auxiliary wiring	IS 375
Code of practice for phosphating iron & steel	IS 6005
Colours for ready mixed paints	IS 5
Code of practice for installation and maintenance of switchgear	IS 3072

## Volume – I Technical Specification for 11KV Indoor Switchgear

### 2.0 PANEL CONSTRUCTION

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows –

2.1	Enclosure Type	Free standing, indoor, Fully compartmentalized, Metal clad, Vermin Proof
2.2	Enclosure degree of protection	IP 4X for High Voltage compartment IP 5X for low voltage compartment
2.3	Enclosure Material	Pre – Galvanized CRCA steel
2.4	Load bearing members	Minimum 2.5 mm thick
2.5	Doors and covers	Minimum 2.0 mm thick
2.6	Gland Plate (detachable type)	3.0mm MS for multicore and 5.0mm Aluminum for single core cables. All gland plates should be detachable type with gasket
2.7	Height of complete Panel	Maximum 2700mm, operating height maximum 1600mm
2.8	Dimension of Instrument Chamber	Depth ( 500mm ) ( Minimum )
2.9	Extensibility	On either side
2.10	Separate compartment for	Bus bar, circuit breaker, HV incoming cable, HV outgoing cable PT, LV instruments & relays.
2.11	Transparent inspection window	For cable compartment at height of cable termination.
2.12	Bus end cable box	For direct cable feeder from bus.
2.13	Breaker compartment door	Separate, with lockable handle (Design with breaker trolley as the front cover is not acceptable). Door of one panel should not cause hindrance for opening of adjacent panel.
2.14	Inter compartmental connections	
2.14.1	Breaker to bus bar compartment	Through seal off bushings
2.14.2	Breaker to cable compartment	Through seal off bushings
2.15	Pressure relief devices	To be provided for each HV compartment.
2.16	Bus support insulator	Non hygroscopic, track-resistant, high strength, Epoxy insulators (calculation for validating dynamic force withstand capability to be submitted during detailed engineering)
2.17	Fixing arrangement	Doors – Concealed hinged, door greater than 500mm shall have minimum three sets of hinges Covers – SS bolts Gasket - Neoprene Gasket arrangement shall be Provided between panels.
2.18	Required HV cable termination height in the cable compartment	650mm ( Minimum ) for 11KV from bottom of the panel
2.19	Panel Base Frame	Steel base frame as per manufacturer's standard.
2.20	Handle	Removable bolted covers with "C" type handle for cable chamber and busbar chamber. Panel no/identification to be provided on cable box cover also.

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<b>2.21</b>	<b>Circuit Breaker</b>	
2.22	Type	Truck type Only.
2.23	Mounting	On withdrawable truck or trolley, with locking facility in service position.
2.24	Switching duty	a) Transformer ( oil filled and dry type ) b) Motor (of small and large ratings – DOL starting with starting current 6 to 8 times the full load current & with a maximum 3 starts per hour) c) Underground cable with length up to 10km.
2.25	Interrupting medium	Vacuum
2.26	Breaker operation	Three separate identical single pole units operated through the common shaft.
2.27	Operating mechanism	Re-strike free, Trip free, with electrical anti-pumping feature
		One O-C-O operation possible after failure of power supply to the spring charging motor.
		Motor wound, spring, charged, stored energy type with manual charging facility
2.28	Breaker Indications and push buttons	
2.28.1	ON/OFF/Emergency trip push button	a) Manual / mechanical b) Emergency Off push button will be provided with a protective flap. c) Mechanical ON shall have padlocking facility.
2.28.2	Mechanical ON-OFF indication	On breaker trolley front
2.28.3	Operation counter	On breaker trolley front
2.28.4	Test-service position indicator	On breaker trolley front
2.28.5	Mechanism charge/discharge indicator	On breaker trolley front
2.29	Breaker positions	Service, test and isolated
2.30	Inter changeability	Possible, only with breaker of same rating
2.31	Breaker control	On panel front only
2.32	Handle	Breaker shall be provided with handles for easy handling, rack in-out operation and manual spring charging as applicable.
2.33	Type of terminal connector at breaker limbs	Jaw Type/Finger type Contacts for breaker limb connection with bus and cable end
<b>3.0</b>	<b>Functional Requirements</b>	
3.1.0	Interlock and safety devices	
3.1.1	Breaker compartment door opening	Opening of door and rack out to test / isolated position should be possible with breaker in OFF position only.
3.1.2	Breaker compartment door closing	Should be possible even when breaker is in isolated position
3.1.3	Racking mechanism safety interlock	Mechanical type
3.1.4	Racking in or out of breaker inhibited	When the breaker is closed
3.1.5	Racking in the circuit breaker inhibited	Unless the control plug is fully engaged

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3.1.6	Disconnection of control plug inhibited	As long as the breaker is in service position
3.2.0	Additional Requirement	
3.2.1	Exposure to live parts	In case the breaker panel door is required to be opened during a contingency, the personnel should not be exposed to any live parts. Suitable shrouds / barriers / insulating sleeves should be provided.
3.2.3	Operation of breaker	In either service or test position
3.2.4	Closing from local	Only when local/remote selector switch is in local position
3.2.5	Closing from remote	Only when local/remote selector switch is in remote position
3.2.6	Tripping from local	Irrespective of selector switch
3.2.7	Tripping from remote	Irrespective of selector switch
3.2.8	Testing of breaker	In test or isolated position keeping control plug connected
3.3.0	Safety shutters	
3.3.1	Automatic safety shutter for female primary disconnects	To fully cover contacts when breaker is withdrawn to test. Independent operating mechanism for bus bar & cable side shutters, separately pad lockable in closed position.
3.3.2	Label for identification	For bus side and cable side shutters
3.3.3	Warning label on shutters of incoming and other connections	Clearly visible label "isolate elsewhere before earthing" be provided
3.4.0	Breaker electrical operation features	
3.4.1	No. of Trip coil	2 Nos for each breaker.  Shunt Trip coil shall operate correctly for all value of voltages between 70% & 110% of rated voltage.  Trip coil shall be suitable for Trip circuit supervision relay for monitoring.
3.4.2	Closing Coil	One no. for each Breaker  Closing coil shall operate correctly for all value of voltages between 85% & 110% of rated voltage.
3.4.3	Trip circuit supervision	To be given for breaker close and open condition
3.4.4	Trip circuit supervision relay contact	For indication, alarm & to inhibit closing of breaker
3.4.5	Emergency Trip Push button contact	Wired directly to trip coil ( wired to Master trip relay if second trip coil provided)
3.4.6		Wired to inhibit closing of breaker
3.4.7	Master trip relay contact	Wired to inhibit closing of breaker
3.4.8	DC Control supply bus in all panels	Fed by two DC Incoming source in bus coupler panel with auto changeover facility
3.4.9	PT supply bus in all panels	Fed normally by Bus PT with automatic changeover facility to incomer line PT
<b>4.0.0</b>	<b>Surge suppressors</b>	
4.1.0	Provision	To be provided in all panels except bus coupler and BPT
	Type	Gapless, metal oxide type
<b>5.0.0</b>	<b>Current Transformers</b>	

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5.1.0	Type	Shall be cast resin type with insulation class of E or better.
	Rating and technical particulars	For all other feature refer technical particulars.
	CBCT	If specified, bidder shall clearly mention his proposal for mounting the same.
<b>6.0.0</b>	<b>Potential Transformer</b>	
6.1.0	Type	Shall be cast resin type with insulation class of E or better.
6.1.1	Mounting	It shall be mounted on a withdrawable carriage. Mounting of PT on the breaker truck is not acceptable. In case it is mounted on the panel rear top, access to the PT and the reinforcement in the panel for allowing a person to stand should be provided.
6.1.2	Neutral	The HV neutral connection to earth shall be easily accessible for disconnection during HV test.
<b>7.0.0</b>	<b>Feeder and Bus Earthing</b>	
7.1.0	Earthing arrangement	Through separate earthing truck for bus and feeder.
7.1.1	Short time withstand capacity of earthing truck	Equal to rating of breaker. Refer technical parameters.
7.1.2	Operation from front	Mechanically operated by separate switch.
7.1.3	Interlocks	To prevent inadvertent closing on the live circuit, with padlocking arrangement to lock truck in close or open position.
<b>8.0.0</b>	<b>Equipment Earthing</b>	
8.1.0	Material of earthing bus	Copper
8.2.0	Earth bus joints	All bolted joints in the bus will be made by connection of two bolts.
8.3.0	Rating	Sized for rated short circuit current for 3 seconds.
8.4.0	Enclosure and non-current carrying part of the switchboard/components	Effectively bonded to the earth bus
8.5.0	Hinged doors	Earthed through flexible copper braid
8.6.0	Circuit breaker frame / carriage	Earthed before the main circuit breaker contacts/control circuit contacts are plugged in the associated stationary contacts.
8.7.0	Metallic cases of relays, instruments and other LT panel mounted equipment	Connected to the earth bus by independent copper wires of size not less than 2.5 sq mm with green color insulation. For this purpose LT compartment should have a clear designated earth bus to which earth connections from all components are to be connected.
8.8.0	CT & PT neutral	Earthed at one place at the terminal blocks through links.
<b>9.0.0</b>	<b>Meters</b>	
9.1.0	Meters	Flush Mounted
9.2.0	Ammeter	Taut band, moving iron type
9.2.1	Size	96 X 96 mm
9.2.2	Panels where to be provided	All panels except Bus PT
9.2.3	Ammeter selector switch	To be provided

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9.2.4	Accuracy class	1.0
9.3.0	Voltmeter	Taut Band, moving iron type
9.3.1	Size	96 X 96 mm
9.3.2	Panels where to be provided	Incomer and bus PT panel
9.3.3	Voltmeter switch	To be provided
9.3.4	Accuracy class	1.0
9.4.0	Energy meter	To be provided alongwith complete communication arrangement. Refer for technical specification/SLD.
9.4.1	Panels where to be provided	All panels except bus coupler and bus PT
9.4.2	Accuracy Class	As per BSES Requirement
9.5.0	Multi functional meter – 3Phase 4 wire Connection	Scrolling facility with LCD display for parameters like power factor, KW, KVA ampere etc. accuracy 0.5 with RS 485 port.
9.6.0	Power Quality Analyser	To be provided alongwith complete communication arrangement. Make and model no. shall be Schneider make PM 8000 Series
9.6.1	Panels where to be provided	All incomer panels
<b>10.0.0</b>	<b>Indication</b>	
10.1.0	Indication	Flush mounted
10.2.0	Lamps	High intensity, clustered LED type
10.2.1	Breaker ON	Red
10.2.2	Breaker Off	Green
10.2.3	Spring Charged	Blue
10.2.4	DC Control supply fail	Amber
10.2.5	AC Control supply fail	Amber
10.2.6	Auto trip	Amber
	Service position	White
	Test position	White
10.2.7	Heater circuit healthy	Yellow ( Indication with integrated push button for checking )
10.2.8	Trip circuit healthy	White
10.2.9	PT supply as applicable	R, Y, B
10.3.0	Hooter with isolation switch	Hooter for AC and Alarm for DC supply failure
<b>11.0.0</b>	<b>Selector switches and push buttons</b>	
11.1.0	Selector switch	Flush mounted on LV compartment door, with shrouded terminals
11.2.0	TNC Switch with pistol grip	Lockable spring return to normal position
11.3.0	Local / SCADA selector switch	As Per BSES Requirement
11.5.0	Selector switch for ammeter	6 way 7 position
11.6.0	Selector switch for voltmeter	6way 7 position
11.7.0	Rotary ON/Off switches	For heater / illumination circuit
11.7.1	Rating	16 A
11.8.0	Push button	Flush mounted on LV compartment door, with shrouded terminals
11.8.1	Emergency trip push button	Red color with stay put

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11.8.2	Accept push buttons	Black color – Trip alarm / DC fail alarm
11.8.3	Reset push buttons	Yellow color – Trip alarm / DC fail alarm
11.8.4	Test push buttons	Blue color – for heater circuit healthy
11.8.5	Rating	10 A
<b>12.0.0</b>	<b>Internal Wiring</b>	
12.1.0	Internal wiring	1100V grade PVC insulated (FRLS) stranded flexible copper wire.
12.2.0	Size	2.5 sq. mm for CT circuit, 1.5 sq mm for PT and 1.5 sq. mm for control circuit
12.3.0	Colour code	
12.3.1	PT	R ph – Red Y Ph – Yellow B Ph – Blue Neutral – Black
12.3.2	CT	R ph – Red Y Ph – Yellow B Ph – Blue Neutral - Black
12.3.3	Others	DC – grey, AC-black, Earth – green
12.4.0	Ferrules	At both ends of wire
12.4.1	Ferrule type	Interlocked type (one additional red color ferrule for all wires in trip circuit)
12.5.0	Lugs	Tinned copper, pre-insulated, ring type, fork type and pin type as applicable. CT circuits should use ring type lugs only.
12.6.0	Spare contacts of relays, timers etc	Wired up to the terminal blocks
12.7.0	Wiring enclosure	Plastic channels, inter panel wiring through PVC sleeves or suitable grommets.
12.7.1	Inter panel wiring	Wiring with ferrule to be terminated in the adjacent shipping section will be supplied with one end terminated and the other end bunched and coiled.
<b>13.0.0</b>	<b>Terminal Blocks (TB)</b>	
13.1.0	Rating and Type	1100V grade, moulded piece, stud type screw driver operated terminals complete with insulated barriers, washers, nuts and lock nuts.
13.2.0	Marking and covers	White fiber markings strip and clear plastic, slip-on/clip-on terminal covers to be provided.
	Disconnecting Facility	To be provided in CT and PT terminals.
	Shorting and Earthing Facility	To be provided in CT Terminals
13.3.0	Spare terminals	20% in each type of TB row
13.4.0	TB shrouds & separators	Moulded non-inflammable plastic material
13.5.0	Clearance	
13.5.1	Clearance between 2 sets of TB	100 mm min.
13.5.2	Clearance with cable gland plate	250 mm min
13.5.3	Clearance between AC / DC set of TB	100 mm min
13.6.0	Test Terminal blocks	Screw driver operated stud type for metering circuit

Note: Earthing trucks for 11KV Panels -2Nos of bus earthing truck and 2Nos of cable earthing truck for each size of panel shall be in Bidders scope.

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<b>14.0.0</b>	<b>Relays and protection</b>	
14.1.0	Technology and Functionality	Numerical, microprocessor based with provision for multifunction protection, control, metering and monitoring.
14.1.1	Mounting	Flush Mounting, IP 5X
14.1.2	Architecture	Hardware and software architecture shall be modular and disconnect able to adapt the protection and control unit to the required level of complexity as per the application.
14.1.3	Programming and configuration	Relay shall utilize a user friendly setting and operating multi-lingual software in windows environment with menus and icons for fast access to the data required. Programming software and communication cord for offered relays should be included in scope of supply.
14.1.4	SCADA Interface port	RS 485 rear port for interfacing with SCADA on IEC 61850 protocol. If relays have any other rear port, hardware/software required to achieve the above said protocol for compatibility will be in supplier's scope.(IF any required converter needs to be consider by vendor).
14.1.5	PC Interface port	Front port (preferably serial) for configuration/data download using PC. Cost of licensed software and communication cord, required for programming of offered protection relays shall be included in the cost of switchgear.
14.1.6	User Interface	An alphanumeric key pad and graphical LCD display with backlight indicating measurement values and operating messages. It should be possible to access and change all settings and parameters without the use of PC.
14.1.7	Relay characteristics	Relay shall integrate all necessary protections for different applications in accordance with IS and IEC. Relay shall provide wide setting ranges and choice of all IEC, IEEE and other tripping curves through a minimum of two setting groups.
14.1.8	Event and Fault records	Relay shall have the facility of recording of various parameters during event/fault with option to set the duration of record through settable pre fault and post fault time. Relay shall store records for last 10 events and 10 faults (minimum). It should be possible to download records locally to PC or to remote SCADA.
14.1.9	General Features of Numerical Relays	Measurement of Event Recording , Disturbance Recording, Harmonic Distortion , RMS Current values & Frequency, Peak and rolling Current Values, Max. and Average current Values, Phase and or Neutral Angles , Max. and average voltage, Power and Energy, Apparent Power and Apparent Power and Apparent Energy with Time Synchronization.
14.1.10	Self diagnosis	Relay shall be able to detect internal failures. A watchdog relay with changeover contact shall provide information about the failure.
14.1.11	Time synchronization	All relays shall be capable of being synchronized with the system clock using SCAD interface and PC.
14.1.12	Digital Input and Digital Output of numerical relays	No. of Digital input / Digital output of any type of relay which shall be used in control and relay panel shall be as per BSES requirement and signal list only. Refer the attached tentative signal list of all feeders (Incomer , Out

Note: All Numerical protection Relay shall be supplied with Conformal coating



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		going, Capacitor Bank , Buscoupler, Station Transformer & Bus PT).
14.1.12	Operation Indicators	LEDs with push button for resetting.
14.1.13	Test Facility	Inbuilt with necessary test plugs for Relays and Meters.
15.1.0	<b>Protection Relays for 11Kv Incomer panel</b>	
	Relay 1	3 phase over current and Earth fault protection with IDMT. Definite time and instantaneous characteristics. Relay shall have both directional and non directional features independently.
		Under voltage and overvoltage protection
		PT supervision ( fuse failure monitoring)
		Sync Check function
	Relay 2	High Impedance Restricted Earth fault protection.
	Note	Combining functions of Relay -1 and Relay-2 in single relay is not acceptable.
15.1.1	<b>Protection Relays for 11Kv Bus section panel</b>	
	Relay 1	Directional 3 phase over current and Earth fault protection with IDMT, Definite time and instantaneous characteristics.. Relay should have Sync check function.
15.1.2	<b>Protection Relays for 11Kv Outgoing panel</b>	
	Relay 1	Directional 3 phase over current and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
15.1.3	<b>Protection Relays for 11Kv Station Transformer panel</b>	
	Relay 1	Directional 3 phase over current and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
15.1.4	<b>Protection Relays for Capacitor panel</b>	
	Relay 1	Directional 3 phase over current and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
		Earth fault protection
		Under voltage and overvoltage protection
		PT supervision ( fuse failure monitoring )
	Relay 2	Neutral unbalance relay ( voltage based ) for each step
		Timer for on time delay ( minimum 300seconds )
	Note	Combining of functions of Relay -1 and Relay -2 in single relay is not acceptable.
16.1.0	Auxiliary Relay – General Features	
16.1.1	Auxiliary Relay use for Circuit supervision, trip and timer relays	Static or electromechanical type
16.1.2	Reset mechanism for auxiliary relays	Self reset contacts except for lock out relays.

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16.1.3	Reset mechanism for lockout relays	Electrical reset type for all type panel.
16.1.4	Operation Indicators	With hand-reset operation indicators (flags) or LEDs with pushbuttons for resetting.
17.1.0	Auxiliary relays – Requirement	
17.1.1	For each breaker	Anti pumping (94), lockout(86) and trip circuit supervision (74) relays
17.1.2	PT selection relays	To be provided for selection between Bus PT and Line PT of respective sections.
17.1.3	Switchgear with two incomers and bus coupler	Lockout (86) contact of each incoming breakers to be wired in series in closing circuit of other incoming breakers and bus coupler.
17.1.4	Auxiliary relays, coupling relays, transducers etc.	To effect interlocks and to exchange signals of status & control from remote.
17.1.5	<b>General Requirements for all relays/contactors</b>	
17.1.6	Auxiliary Supply	220/50VDC. All relays / contactors shall be suitable for continuous operation at 15% overvoltage.
<b>18.1.0</b>	<b>Space Heaters</b>	
18.1.1	Space heaters	Thermostat controlled with switch for isolation
18.1.2	Space heater location	Breaker & HV cable compartment to be mounted on a insulator. Heater position in cable compartment should be easily accessible after cable termination. Heater position in breaker chamber shall be accessible with breaker racked-in.
<b>19.1.0</b>	<b>Switch and sockets</b>	
19.1.1	Lamp with switch	For LV & cable chamber
19.1.2	Universal type (5/15A) socket with switch	In LV chamber
<b>20.1.0</b>	<b>Name Plates and Marking</b>	
	Nameplates	To be provided as per the following description
	Equipment Nameplates	<ol style="list-style-type: none"> <li>All equipment mounted on front side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.</li> <li>All front mounted equipment shall be also provided at the rear with individual name plate engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.</li> </ol>
	Feeder Nameplates	<ol style="list-style-type: none"> <li>Large and bold name plate carrying the feeder identification/numbers shall be provided on the top of each panel on front as well as rear side. On rear side, nameplate should be provided on frame.</li> <li>Rear bottom of each panel shall have a nameplate clearly indicating the following: Customer Name – Project details; PO No and date; Drawing Reference No.etc.</li> </ol>
	Rating Plate	<p>Following details are to be provided on Panel and CB rating plate;</p> <ol style="list-style-type: none"> <li>Customer Name – BSES Delhi</li> </ol>

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		b. P.O.No. and Date – As per respective PO.
	Material	Non – rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering. Stickers are not allowed.
	Fixing	All nameplates / rating plates shall be riveted to the panels at all four corners. Bolting / screwing is not acceptable.
	Markings	Each switch shall bear clear description identifying its function. Similar inscription shall also be provided on each device whose function is not otherwise identified. If any switch or device does not bear this inscription separate nameplate giving its function shall be provided for it. Switch shall also have clear inscription for each position indicating e.g. Trip – Neutral close, ON-OFF etc.
<b>21.1.0</b>	<b>Surface treatment &amp; painting</b>	
21.1.1	Surface treatment	Sand blasting or by seven tank process
21.1.2	Paint type	Powder coated. Pure polyester base grade A structure finish
21.1.3	Paint shade	RAL 7032 for external & internal surface
21.1.4	Paint thickness	Minimum 50 microns
<b>22.1.0</b>	<b>Inspection and testing</b>	
22.1.1	Type Tests	The product must be of type tested quality as per all tests in Indian standards
22.1.2	Type test report validity period	Last five years from date of bid submission
23.1.0	Stage and Final Inspection	All the Qty. of Panels will be inspected by BSES as per approved QAP.
23.1.1	Acceptance & routine test	As per the specification and relevant standards. Charges for these tests shall be deemed to be included in the equipment price.
		The Owner/owner reserves the right to witness all the tests.
23.1.2	Notice to Owner for conducting type tests.	At least three weeks in advance.
23.1.3	Test reports of acceptance and routine tests before dispatch for approval	To submit six copies
23.1.4	Submission Of QAP	QAP will be submitted by suppliers with submission of Schematic Drawings.
24.1.0	Deliverable	1.As Built Drawing of panel 6 Sets 2. Maintenance Manuals – 2CD / DVD Soft Copy , 6 Set of Hard Copy 3. Relay and equipments Catalogues & Manuals 4. Relay Settings & Maintenance Manuals 5. Relays software and connection/ communication cables
25.1.0	Training	Training on relays and equipment operations shall be provided to the officials of BRPL will be in the Scope of Suppliers.
<b>26.1.0</b>	<b>Approved Make of components for 11KV Switchgear Panel</b>	
26.1.1	Numerical Relays	ABB / SCHNEIDER / SIEMENS Numerical relays used in complete switchboard should be of same make.

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26.1.2	Auxiliary Electromechanical Relays	ABB / Alstom / Schneider / Siemens
26.1.3	Contactors / Auxiliary Relays	Schneider Electric / Siemens / ABB
26.1.4	Analog Ammeter / Voltmeter	AE / Rishabh
26.1.5	Indication LED , Lamp	Teknic/ Siemens
26.1.6	Push Button	Teknic
26.1.7	Field Terminal Block	Phoneix / Elemex / Connect well
26.1.8	MCB	Schneider / Siemens / ABB
26.1.9	Hooter	Alan
26.1.10	Panel Light	Philips / Bajaj / Surya
26.1.11	Power Socket	Anchor / Reputed make
26.1.12	Multifunction Meter	Rishabh
26.1.13	Wires for wiring	KEI / Finolex / Polycab
26.1.14	Test Terminal Block	Areva / IMP / Nelster
26.1.15	Control Switch	Areva / Switron
26.1.16	Instrument Transformers	ECS / Pragati / Kappa / Narayan power tech
26.1.17	Surge Arrestor	Oblum / Lamco / Raychem
26.1.18	Energy Meter	HPL (Grid Meter for BRPL)
26.1.19	Vacuum interrupter make	Schneider, Siemens , BEL,BHEL,ABB , CGL & L&T.

**3.0 DEVIATIONS**

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.

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**ANNEXURE – B**

**GUARANTEED TECHNICAL PARTICULARS (DATA BY OWNER)**

<b>1.0.0</b>	<b>Switchgear</b>	
1.1.0	Type	Metal clad, air insulated with VCB type circuit breaker
1.2.0	Service	Indoor
1.3.0	Mounting	Free standing, floor mounted
1.4.0	System voltage	11KV
1.5.0	Voltage variation	+ / - 10%
1.6.0	Frequency	50HZ + / - 5%
1.7.0	Phase	3
1.8.0	Rated voltage	12KV
1.9.0	Rated current @ 50 DEG C ambient	As per SLD
1.10.0	Short time rating for 3 sec.	26.3KA
1.10.1	Insulation level (PF rms / impulse peak)	28 / 75 KV
1.11.0	System ground	Effectively earthed
1.12.0	Enclosure degree of protection	IP – 4X for high voltage compartment and IP – 5X for metering and protection compartment
1.13.0	Bus bar – Main @ 50 <sup>0</sup> C ambient	Rating as per SLD, Short time rating as per 1.10
1.14.0	Material	Silver plated/ tinned electrolytic copper
1.15.0	Bus Bar sleeve	Sleeved with shrouds on joints. Tape on joints is not acceptable.
1.16.0	Bus identification	Colour coded
1.17.0	Temperature rise	40DEG C for conventional joints, 55DEG C for silver plated joints
1.18.0	Auxiliary bus bar	Electrolytic grade tinned copper
1.19.0	Auxiliary DC Supply	220V/ 50V DC
1.20.0	Auxiliary AC supply	240V AC 50HZ
1.21.0	Hardware	Stainless steel
1.22.0	Earth bus	Aluminum
1.23.0	Power and control cable entry	From bottom
<b>2.0.0</b>	<b>Circuit Breaker</b>	
2.1.0	Voltage class, insulation level, short time rating	As specified for switchgear
2.2.0	Rated current	As per SLD. Use of two breakers in parallel to meet the required current rating shall not be acceptable.
2.3.0	Duty cycle	O – 0.3sec – CO – 3min – CO
2.4.0	Short circuit rating	
2.5.1	AC sym. Short circuit current	26.3KA

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2.5.2	Short circuit making current	62.5KA
2.6.0	Operating time	
2.6.1	Break time	Not more than 4 cycles
2.6.1	Make time	Not more than 5 cycles
2.7.0	Range of auxiliary voltage	
2.7.1	Closing	85% - 110%
2.7.2	Tripping	70% - 110%
2.7.3	Spring charging	85% - 110%
2.8.0	No. of spare aux. Contacts of breaker, for owner's use	Minimum 6 NO + 6 NC
2.8.1	No. of spare contacts of service and test position limit switch	2 NO
<b>3.0.0</b>	<b>Current Transformers (Refer SLD)</b>	
3.1.0	Voltage class, insulation level, short time rating	As specified for switchgear
3.2.0	Type	Cast resin, window / bar primary type
3.3.0	Class of insulation	Class E or better
3.4.0	Ratio	As per SLD, secondary shall be 1 A
3.5.0	Number of secondary	3
3.6.0	Accuracy class	
3.6.1	Protection core	5P20
3.6.2	Core balance CT	PS
3.6.3	Protection Diff / REF	PS
3.6.4	Metering	0.2s
3.6.5	VA output	As per calculation
3.6.6	Excitation current of PS class CT's	30mA at $V_k/4$
3.6.7	Primary operating current sensitivity of CBCT's.	5A
<b>4.0.0</b>	<b>Voltage Transformers (Refer SLD)</b>	
4.1.0	Type	Cast resin, draw out type, single phase units
4.2.0	Rated Voltage	
4.2.1	Primary	$11000/\sqrt{3}$
4.2.2	Secondary	$110/\sqrt{3}$
4.2.3	No of phases	3
4.2.4	No. of secondary windings	2
4.2.5	Method of connection	Star/Star
4.2.6	Rated voltage factor	1.2 continuous, 1.9 for 30 seconds
4.2.7	Class of insulation	Class E or better
4.3.0	Accuracy class	
4.3.1	- Protection	3P
4.3.2	- metering	0.2
4.4.0	Primary and secondary fuses	HRC current limiting type, primary fuse replacement shall be possible with VT in withdrawn position
<b>5.0.0</b>	<b>HV Fuses</b>	
5.0.1	Voltage class	12KV
5.0.2	Rupturing capacity	50KA

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5.0.3	Rated current	As per application
<b>6.0.0</b>	<b>Surge Arrestors</b>	
6.0.1	Rated voltage	9kV
6.0.2	Maximum continuous operating voltage ( MCOV )	7.65kV
6.0.3	Discharge current	10kA
6.0.4	Discharge Class	3

**TECHNICAL SPECIFICATION**

**FOR**

**CABLE INSTALLATION & ACCESSORIES**

Prepared by	Javed Ahmed		Rev: 1
Reviewed by	Abhinav Srivastava		Date: 12 <sup>th</sup> June 2018
Approved by	K.Sheshadri		



## Technical Specification for Cable Installation and Accessories

### 1.0 INSTALLATION OF CABLES:

- 1.1 The cable shall be laid as per IS 1255. The Contractor shall prepare cable schedules for all the cable circuits associated with the equipment in the substation showing length, size and routing of each cable which shall be given suitable code numbers and submit the same for Owner's/Engineer's information/approval. Cable and Conduit laying shall be done strictly in accordance with the cable schedules.
  - 1.2 The control and power cables shall be laid in conduits, concrete pipes, ducts, trays or cable trenches unless indicated otherwise. The power and control cables shall be laid in different trays. Cables shall be cleated to the cable tray after properly dressing.
  - 1.3 Ducts shall be provided wherever cable trenches cross roads with provision of one spare duct for future use.
  - 1.4 All civil works, viz, excavations, sand cover, providing brick cover on directly laid cables, construction of foundations, trenches with cable tray supports, cable ducts under roads, back filling, finishing associated with cabling work shall be duly completed.
  - 1.5 The Contractor shall supply and install all the surface mounted/ embedded rigid and flexible conduits, their connections, and associated clamps, bushings, lock-nuts, caps etc required in the cabling work.
  - 1.6 All conduits and their accessories shall be made of galvanized heavy gauge steel as per BIS Specification. The internal bore of all pipes shall be smooth and suitable for pulling PVC sheathed cables without damage.
  - 1.7 The Contractor shall supply all fittings including ordinary tees and elbows, check nuts, male and female fittings pull boxes, junction boxes, conduit outlets, outlet boxes, splice boxes, terminal boxes, gaskets and box covers, saddles and all supporting steel work and all such arrangements which are required to complete the conduit installations.
  - 1.8 Pre-fabricated junction boxes, conduit boxes and conduits shall be shop fabricated out of malleable iron or steel plates and shall be galvanized and provided with galvanized malleable iron or steel plate covers and rubber gaskets
  - 1.9 All the apparatus, connections and cable work shall be designed and arranged to eliminate the risk of fire and minimize damage which might be caused in the event of fire. Wherever cables pass through floor or wall openings or other partitions, suitable bushes of approved type shall be supplied and put in position by the Contractor.
  - 1.10 Standard cable grips, reels and rollers shall be utilized for cable pulling.
  - 1.11 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing cable reference number indicated in the cable schedule prepared by the Contractor, at every 10 meter run and at both ends of the cable, adjacent to the
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## Technical Specification for Cable Installation and Accessories

terminations as well as where cables enter or leave ducts. Cable routing shall be so done that cables are accessible for identification and maintenance easily, and are arranged neatly.

- 1.12 In no case the cables shall be bent sharply or kinked with the radius of bending falling below  $15D$  where  $D$  is the overall diameter of the cable.
- 1.13 When power cables are laid in the proximity of communication cables, the minimum horizontal and vertical separation between power and communication cables shall be 600 mm. Wherever possible the power and communication cables shall be located as far from each other as possible. The power and communication cables shall cross each other at right angles.
- 1.14 Wherever cables cross roads, water, oil, sewage or steam-lines, special care shall be taken while designing the trenches/ducts for protection of the cables.
- 1.15 In each cable run, some extra length shall be provided at a suitable location to enable making of one or two straight-through joints for carrying out repairs if the cable develops fault at a later date.
- 1.16 Cable splices shall not be permitted except where called for as per the construction drawings, or where permitted by the Engineer. Straight-through joints in the run of cables wherever unavoidable shall be through joint-boxes.
- 1.17 The termination of cables at various equipments shall be carefully made in accordance with the manufacturer's instructions and detailed connection diagrams.

Termination materials for all cables shall match with the type of cable insulation and have thermal and electrical ratings and chemical properties similar to those of the associated cable.

All terminating materials except for those already supplied with the electrical equipment shall be provided by the Contractor.

- 1.18 Control cable terminations shall be made in accordance with the color code marked wiring diagrams of control circuits. Multi-conductor control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, to the extent possible. The insulated conductors from which the jacket is removed shall be neatly trained in bundles and terminated. The bundles shall be firmly, but not tightly, tied utilizing plastic or nylon ties or specially treated fungus-proof cord.
  - 1.19 The connectors for control cables shall preferably terminate in Ross Courteny terminals and washers and be covered with transparent insulating sleeves so as to prevent accidental contact with ground or adjacent terminals. The insulating sleeves shall be fire resistant and shall be long enough to overlap the conductor insulation.
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### **Technical Specification for Cable Installation and Accessories**

1.20 When control cables are to be fanned out and tied together with cord, the Contractor shall make connections to terminal blocks and test the equipment for proper operation before tying the cables together with cord.

1.21 Jointing of cables shall be made in accordance with the applicable Bureau of Indian Standards Code of practice, Owners approval and manufacturer's special instructions. The materials and tools required for cable jointing work shall be in the Contractor's scope.

1.22 The supply of joint boxes shall include all hardware fittings, compounds, tapes and other materials required for making the joints.

Special tools, clips and saddles, glands, seals, PVC sealing compound, locknut, etc, required for connection and termination of cables shall be in the Contractor's scope.

1.23 All cables shall be megger-tested before jointing. After jointing is completed all L.V cables shall be megger-tested.

Cable cores shall be tested for:

- i. Continuity.
- ii. Absence of cross phasing
- iii. Insulation resistance to earth.
- iv. Insulation resistance between conductors.

### **2.0 CABLE TRAYS, ACCESSORIES & TRAY SUPPORTS, CONDUITS, PIPES AND DUCTS**

2.1 Cable trays shall be run either in concrete cable trench or overhead supported from building steel. The cable trays shall be ladder type for power cable and perforated type for Control cable. The trays shall be supplied with matching fittings and accessories.

2.2 Cable tray shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. Minimum thickness of cable trays shall be 2.0mm.

2.3 Cables shall be clamped to the cable trays in the horizontal runs with 18 gauge GI wires. For vertical runs the cables shall be clamped with suitable site-fabricated clamps.

2.4 All cable trays including perforated sheet trays, weld mesh trays, vertical raceways shall be hot-dip galvanized and epoxy coated. The trays shall be of standard width of 150mm, 300mm, 450mm & 600mm and standard length of 2.5M. Trays upto 300mm shall be perforated type and above 300 mm shall be ladder type.

2.5 The conductors carrying AC and DC supplies shall not be bunched together in a conduit. Where single-core cables are individually drawn into separate pipes, HDPE pipes shall be used.

### **Technical Specification for Cable Installation and Accessories**

- 2.6 Flexible metallic conduits shall be used for termination of connections to equipment to be disconnected at periodic intervals and also for termination of connections to level switches, limit switches, pressure switches etc.
  - 2.7 In order to minimize condensation or sweating inside the conduit, all outlets of the conduit system shall be properly drained and ventilated so to prevent entry of insects and water as far as possible.
  - 2.8 The conduits or pipes shall be run along walls, floor and ceilings, on steel supports, embedded in soil, floor, wall or foundation, in accordance with the relevant layout drawings, approved by the Owner.
  - 2.9 All fittings in the conduit systems having threaded connections shall be tightened with full thread engagement and with a minimum of wrench work in order to avoid wrench outs.
  - 2.10 Embedded conduits running parallel to a masonry surface shall, wherever possible, have a cover of at least 38 mm.
  - 2.11 The conduits shall be lead into terminal boxes through the entry points provided by the equipment manufacturers unless otherwise shown in the drawings or unless otherwise directed by the Engineer.
  - 2.12 While installing asbestos pipe or other fiber conduit, cracked pieces shall not be used. The sections cracked or broken during or after placement shall be replaced.
  - 2.13 For underground conduit runs the Contractor shall excavate and backfill as necessary.
  - 2.14 Exposed conduit shall be adequately supported by racks and clamps or straps or by other approved means.
  - 2.15 Where conduits are stubbed out of masonry for future extension outside the structure, they shall be specially protected against corrosion and shall be boxed in against possible physical damage.
  - 2.16 Each conduit run shall be marked with its designation as indicated on the drawings - 'Identification'.
  - 2.17 Where conduit and boxes in locations of severe exposure require, painting of galvanized surfaces with Alkyd Resin Zinc Dust paint following by a finish coat of Aluminum paint, shall be performed by the Contractor in a good and approved manner.
  - 2.18 The Contractor shall bond of metal pipes or conduits in which cables have been installed to the main earthing system.
  - 2.19 The conduits and accessories shall be adequately protected against mechanical damage as well as corrosion.
-

## Technical Specification for Cable Installation and Accessories

### 3.0 TERMINATION AND STRIGHT THROUGH JOINTS

- 3.1 Termination and jointing kits for 11KV and 33KV grade XLPE insulated Aluminum cables shall be proven design and make already been extensively used and type tested. Termination kit and jointing kits shall be pre moulded type, taped type or heat shrinkable. The joints and termination shall be tested as per IS 13573. The kit contents shall be of proven design and type tested. Kit contents shall be supplied from the same source as were used for type tested. The kit shall be complete with Aluminum solderless crimping cable lugs and ferrules as DIN standard

The termination kit make and specification shall be strictly as per approval of the Owner.

- 3.2 The straight through and termination kit shall be suitable to withstand the fault level for 11KV and 33KV system

### 4.0 CABLE GLANDS, LUGS & ACCESSORIES

- 4.1 The cable shall be terminated using double compression type cable glands. The cable glands shall confirm to BS 6121 and of robust construction capable of clamping the cables and armour firmly without injury to the insulation. The cable glands shall be made out of heavy duty brass machine finished and nickel chrome plated. The thickness of plating shall not be less than 10 micron. The rubber component shall be made out of neoprene and tested quality.
- 4.2 The trefoil clamps for single core cables shall be pressurized die cast Aluminum or fiber Glass or Nylon and shall include necessary fixing accessories such as GI bolts and nuts. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by short circuit current.
- 4.3 Cable End seal (Roxtec/MCT Brattberg) shall be provided for all Control Cable and Power Cable (including outgoing HT panels) at all the points wherever cable entries in the control room building or between room to room. 30% Spare modules shall be provided along with centre core has to be provided. System shall take up variation margin of +/-3mm in diameter of Cable. For details refer specs.

### 5.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.

**TECHNICAL SPECIFICATION**

**FOR**

**EXHAUST & VENTILATION SYSTEM  
INCLUDING AIRCONDITIONING**

<b>Prepared by</b>				<b>Rev: 0</b>
<b>Reviewed by</b>				<b>Date:</b>
<b>Approved by</b>				

## **Technical Specification Exhaust and Ventilation System**

### **1.0 INTENT OF SPECIFICATION**

- 1.1 This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport for site of Air Conditioning system and Ventilation system for substation control room building complete with all materials and accessories for efficient and trouble free operation
- 1.2 In the event of any discrepancy with the listed documents, the stipulation this specification shall govern.

### **2.0 SCOPE OF SUPPLY**

The following equipment shall be furnished with all accessories.

- a) Exhaust Fan system.
- b) Air Conditioning
- c) All necessary components for operation of the above equipment.
- d) All wiring & accessories to complete the installation.
- e) All relevant drawings, data & instruction manuals.
- f) Mandatory spares.
- g) Commissioning spares and recommended spare part list for three (3)

### **3.0 GENERAL REQUIREMENT**

- 3.1 All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards except where modified and/or supplemented by this specification.
  - 3.2 Equipment and materials conforming to any other standard, which ensures equal or greater quality, may be accepted. In such case copies of the English version of the standard adopted shall be submitted along with the bid.
  - 3.3 In particular, the following standards and specifications are applicable.
  - 3.4 Air conditioners suitable for 230V, 50 Hz single phase AC supply shall be capable of performing the functions as cooling, dehumidifying, air circulating and filtering. The air conditioners shall be complete with automatic temperature control and cut-in and cutout etc. for temperature range 16 to 25 degree C.
  - 3.5 Outdoor unit of the air conditioners shall be fitted discharge cooled type rotary Compressor.
  - 3.6 Air Conditioner shall be 5 Star rated
-

**Technical Specification Exhaust and Ventilation System**

- 3.7 Air Conditioning shall maintain 22 Degree Celsius in summers and Winters, Environment condition shall be referred from General Design Criteria Chapter 1
- 3.8 Approved make of AC is Voltas/LG/Carrier.
- 3.9 The minimum thickness of the base in outdoor unit shall be 1.20 mm & sheet thickness for rest of the body shall be 0.70 mm (Min.) with galvanized coating thickness of 120 g/ sq. m and shall be provided with stiffeners for robust construction and shall have rounded corners.
- 3.10 The casing of the indoor units shall be made of ABS/HIPS/GS and shall be impact resistant. The control box of indoor unit shall withstand flame retardant.
- 3.11 Remote cordless control with LCD/LED Display for Air conditioner shall be provided with one On/Off timer, selecting fan speed (three speed) and setting up of temperature. Display shall be provided on indoor unit or on handset or on both.
- 3.12 Maximum power consumption of the split air conditioners shall be measured at capacity rating test conditions. Overall power factor of the unit shall be at least 0.85 at capacity rating test conditions

This specification shall be read and constructed in conjunction with the bid documents and annexure to determine the scope of work.

**DESIGN CRITERIA**

	Air Conditioning shall be supplied in Control Room and Switchgear Room including GIS Room, maintenance room and SCADA room. Exhaust system shall be supplied in following rooms -Toilet – one Pantry- One Cable Celler- Industrial type numbers shall be as per calculation
Number and details of wall mounted/Ceiling fan	Battery room – 1 No Control room – 3 No's Switchgear Room – 6 No's GIS Room-As per Calculation, 6 Nos(Minimum). <b>Note: Wall mounted fan shall be industrial type, domestic fans shall not be acceptable</b>
Power Point & socket	Each room shall be provided with at least 2 No's 15 Ampere Switch socket and 2 no's 5 ampere switch sockets. Two no's industrial 16 ampere points shall be provided in control room for installation of air conditioning system for future.



## Technical Specification Exhaust and Ventilation System

	All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.
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### 4.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.

**TECHNICAL SPECIFICATION**  
**FOR**  
**FIRE EXTINGUISHER**

<b>Prepared by</b>				<b>Rev: 1</b>
<b>Reviewed by</b>				<b>Date: 24.05.21</b>
<b>Approved by</b>				

## Technical Specification Fire Extinguisher

### 1.0 INTENT OF SPECIFICATION:

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport FOR site of Portable wall and trolley mounted Fire extinguisher and fire buckets for substation control room building complete with all materials and accessories for efficient and trouble free operation.

In the even of any discrepancy with the listed documents, the stipulation of this specification shall govern.

### 2.0 SCOPE OF WORK

#### 2.1 Scope of Supply

The following equipment shall be furnished with all accessories:-

- a) Wall mounted fire extinguisher-15 Nos. of 4.5kG (CO2 Type)
- b) Trolley mounted fire extinguisher- 5 Nos. of 22.5kg (CO2 Type)
- c) Sand buckets with stand- 4 Set with 4 bucket in each stand
- d) All installation hardware.
- e) All relevant drawings, data & instruction manuals.
- f) Mandatory spares.
- g) Commissioning spares and recommended spare part list for three (3) years of operation.
- h) Rubber Mat for entire Indoor equipments front and backside(as per latest IS)

### 3.0 GENERAL REQUIREMENT

#### 3.1 Codes and Standard

All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards except where modified and/or supplemented by this specification.

Equipment and materials conforming to any other standard which ensures equal or greater quality may be accepted. In such case copies of the English version of the standard adopted shall be submitted along with the bid.

In particular, the following standards and specifications are applicable.

## Technical Specification Fire Extinguisher

Indian Electricity Rules	Relevant safety regulation of CEA
Indian electricity act	
IS 2190	Selection, installation & maintenance of first aid, fire extinguisher.
	Tariff Advisory Committee Manual
IS 1646	Code for practice for fire safety of buildings
IS 940	Portable fire extinguisher, Water type - specification
IS 2878	Fire extinguisher CO2 type
IS 2171	Specification for fire extinguisher dry powder.
IS 10204	Specification for fire extinguisher Mechanical foam type.

This specification shall be read and constructed in conjunction with the bid documents and annexure to determine the scope of work.

### 4.0 DESIGN CRITERIA

General	The contractor shall supply the required type and quantities of fire extinguisher and Sand buckets. The quantity shall be as per TAC recommendations.
Location	Fire extinguisher and sand buckets shall be installed in Control room, battery room, switchgear room, ACDB & battery charger room, Cable cellar, Transformer yard, Outdoor switchyard and Capacitor bank.
Distribution	The fire extinguishers in various locations shall be as per the guidelines of TAC-India.
Tests	All equipment shall be completely assembled wired, adjusted and routine tested at the factory as per relevant standards.

### 5.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.



**TECHNICAL SPECIFICATION  
FOR  
FIRE SUPPRESSION SYSTEM**

Specification No- GN101-03-SP-139-00

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 1</b>
<b>Checked by</b>	<b>Javed Ahmed</b>		
<b>Reviewed by</b>	<b>Abhinav Srivastava</b>		
<b>Approved by</b>	<b>Sheshadri Krishnapura</b>		<b>Date: 21 May 2021</b>

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**Registered Office: BSES Bhavan, Nehru Place, Delhi - 110019**

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- 2.0 Code and Standards
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**1.0. SCOPE:**

Switchgear Panel Fire Suppression System: This includes Supply, Installation, Testing and Commissioning of Suppression system.

**2.0. CODE AND STANDARDS:**

This specification shall be governed by following standards/rules & regulations with all amendments unless otherwise specified in this specification.

S.No.	Standard Name / No	Standard's Description
1	AS 1670.1, AS1603.8, ASNZS 3000	Latest Edition
2	Indian electricity act 2013	Latest Edition
3	Fire Industry Association (FIA), Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) Systems	Latest Edition
4	NFPA Standards	2001 (2015 Edition)
5	NEC Standards, US	Latest Edition
6	NZS 4512	2003
7	Residential Fire and Burglary:– Household Fire Warning System Units – ANSI/UL 985, 2000/05/26 (5th edition) with revisions up to 2004/04/29	Latest Edition
8	IS-875	Latest Edition
9	Local Fire Authority	Delhi
10	National Building Code	Part 4 Fire and life safety 2016

**3.0. SERVICE CONDITIONS:**

S.No	Particulars	Data
1	Design Ambient temperature	0°C to 50 °C
2	Seismic Condition	Zone IV as per IS 1893
3	Wind Pressure	195 kg/M <sup>2</sup> upto elevation of 30 M as per IS 875
4	Maximum Relative Humidity	100%
5	Maximum Altitude above Sea level	1000M

6	Rainfall	750mm (concentrated in 4 months)
7	Pollution level	Heavy/Dry
8	Average of no thunderstorm days	40 per annum

#### **4.0. Scope of Work:**

- a. Supply, Installation, Testing and Commissioning of clean Agent Novec 1230 Fire Suppression system designed to provide a uniform concentration within the electrical panels in accordance with NFPA 2001 and requirements of the contract documents.
- b. Provide all engineering design and materials for a complete agent suppression system including Novec 1230 storage cylinders with steel bracket, extinguishing agent, detection tube, cylinder valve and associated accessories including but not limit to; adaptors, pressure switch, Fire Detection tube fittings etc, required for complete operation of system.
- c. All necessary safety requirements such as warning signs, discharge alarm shall be part of system.
- d. The necessary nomenclature such as pressurization level, agent volume, and gross/net weight of cylinder shall be clearly marked on cylinder.
- e. Prior to supply of material at site. Contractor must submit following documents for approval of Engineer-in-charge.
- f. Drawing in A-4 size, clearly showing the panel, routing of tube inside the panel, location and fixing arrangement of cylinder & system components.

#### **5.0 System Description:**

- a) The detection tube shall be fixed with cylinder valve at top of cylinder. The tube shall be pressurized with dry nitrogen at 16 bars. In case of fire and on reaching of pre-determined temperature, the tube shall rupture and gas shall be released from tube/ discharge nozzle over the protected area.



- b) The pressure switch shall be provided for necessary indication of discharge of gas.
- c) The Extinguishing Agent shall be stored in cylinder as liquefied compressed gas, super pressurized with dry nitrogen at 195 psi minimum
- d) The cylinder shall be equipped with brass valve, pressure gauge (to monitor agent pressure) and isolation valve for maintenance purposes. The cylinder bracket shall be of steel construction with quick release clamp.
- e) The detection tube shall be installed throughout the compartments of panel. The location and spacing of tube shall be above the hazard, to be protected.
- f) In case of ILP System Nozzles shall be placed properly over the protected area.
- g) With system activation, a signal should be generated via Audio Visual Alarm installed at convenient location as per Engineer-in-Charge.

#### **6.0 System Components:**

The bidder shall provide an under taking from Principle Manufacturer of product they intent to install, that manufacturer will fully support the bidder for this specific project.

- a) Cylinder of steel construction with standard red epoxy paint finish. Cylinders shall be accompanied by original manufacturers test certificate confirming the contents of the cylinder.
- b) The cylinders shall be from reputed Manufacturers only. Cylinders shall be super pressurized with dry nitrogen to an operating pressure and temperature as per manufacturer recommendations.
- c) Each cylinder shall have pressure gauge and low pressure switch to provide visual and electrical supervision of the cylinder pressure. The low pressure switch shall be wired to the Audio Visual Alarm to provide audible and visual trouble alarm in the event of drop of pressure. The pressure gauge shall be color coded to provide an easy, visual indication of cylinder pressure.

- d) Furnish a welded steel bracket with each cylinder assembly for holding the cylinders in a saddle with a front bracket piece that secures the cylinders.
- e) The Detection Tube, should be UL approved, UL approval marking, Red Color.
- f) The Pressure Switch should be UL Listed/CE Marked having NO/NC contact.
- g) DLP/ILP Valves should be CE/ISO/EN approved and π marked.
- h) All the Power and Control Cables shall be FRLS type.
- i) System shall give signals to SCADA on through communication port.

**MANDATORY APPROVALS/CERTIFICATES SHALL BE REQUIRED**

1. Authorization letter from Principal OEM of System
2. Authorization Letter from OEM of Clean Agent(UL/FM).
3. Pneumatic Heat Sensing Tube- UL Listed and marked
4. Valve shall be π marked
5. Pressure Switch Assembly: UL/CE approved
6. UL Approved filling station.

**7.0. MAINTENANCE**

Bidder shall furnish a maintenance manual and support maintenance activity.

**8.0. DRAWING AND DATA SUBMISSION**

8.1	Submissions along with the bid	
8.1.1	Duly filled GTP and copy of specification	2 copies + 1 soft copy

**9.0. SHIPPING**

9.1	Shipping	The bidder shall ascertain at an early date and definitely before the commencement of
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		<p>manufacture, any transport limitations such as weights, dimensions, road culverts, Overhead lines, free access etc. from the Manufacturing plant to the project site. Bidder shall furnish the confirmation that the proposed Packages can be safely transported, as normal or oversize packages, up to the site.</p> <p>Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.</p>
		<p>The Bidder shall be responsible for all transit damage due to improper packing.</p>

## 10.0. HANDLING AND STORAGE

10.0	Handling and Storage	<p>Manufacturer instruction shall be followed. Detail handling &amp; storage instruction sheet / manual needs to be furnished before commencement of supply.</p>
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## 11.0. QUALITY & INSPECTION

11.1	Vendor quality plan	To be submitted for purchaser approval
11.2	Testing & Inspection	As per relevant standards

## 12.0 Warranty

Warranty shall be 5 Years Minimum. Vendor shall provide free maintenance during warranty period.

Following activities shall be included during period of warranty.

1. one visit by service engineer for general check up -- once in a six month time on each location.
2. Functionality test of the entire system -- once in one year time on each Location.

3. Mandatory Spares shall be provided for upkeeping of system for the period of 5 Years.

**13.0 DEVIATION**

13.1	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.
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**14.0 TRAINING**

Training on installation, commissioning, operation and maintenance shall be included in the quotation.

- At site after installation- 1 Manday



**TECHNICAL SPECIFICATION**  
**FOR**  
**VIDEO SURVEILLANCE SYSTEM**

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 2</b>
<b>Reviewed by</b>	<b>Abhinav Srivastava</b>		
<b>Approved by</b>	<b>K.Sheshadri</b>		<b>Date: 2<sup>rd</sup> Feb 2021</b>

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**Registered Office: BSES Bhavan, Nehru Place, Delhi - 110019**

**1. SCOPE:**

Design, Engineering, procurement of bought out items, manufacture, integration, inspection, factory testing and supply of complete CCTV System for the entire plant as per requisition consisting of following including necessary hardware, software and accessories as applicable.

**2. STANDARDS:**

In accordance with Latest Relevant IS/IEC.

**3. SCOPE OF SUPPLY:**

- CCTV cameras suitable for remote operation with all necessary accessories and installation hardware consisting of, but not limited to the following:
  1. High speed zoom lens.
  2. 360 Degree Cameras
  3. Automatic Iris
  4. Pan & tilt unit
  5. Receiver unit
  6. Weatherproof junction box
  7. Weatherproof housing for unit camera.
  8. Glass Dome with reflector shield on outside.
  9. Night Vision.
  10. One set of 360 camera shall be installed before start of work
- System cabinet consisting of following:-
  1. Video encoder, network switches, etc.
  2. Central control unit with all control functions like pan, tilt, focus and consisting of switching unit.
  3. Video Motion Detection system
  4. Video recorder to record video images
- 2 Nos -21" FULL HD, LED Monitor with HDMI interface to CPU with Keyboard, Optical Mouse for monitoring at Main Control Room & Security Security Room.
- Monitoring unit also including Programming unit consisting of programming Monitor LED 21", keyboard and optical mouse, independent of monitoring unit with all required hardware and software for CCTV functioning.
- All furniture required in the Control room and Security Gate, to mount the CCTV equipment like TV, PC, keyboard , DVR, etc.
- All types of Cables (Video, Control/data, Optic Fiber and Power Supply etc.), cable glands, plugs, connectors and accessories, for interconnection of all the equipments supplied by vendor.
- Junction boxes, Power distribution boxes, repeaters, cable glands, etc. as necessary.
- Mounting poles for mounting the camera along with a climbing ladder.
- The Ladder to be provided with wheels & brakes for easy movement on roads.

- HDPE pipe with required pipe fittings for laying optical fiber cables between CCTV Cameras and main control room, and between main control room and security control room (gate / security house).
- Cable trays for CCTV cables within control rooms with required accessories in case required at site. Cable trays outside control room (where main cable duct is not available). Buried cable trench for cabling along the boundary walls.
- All necessary supports for installation of all items supplied by vendor.
- All mounting accessories required to mount various items supplied by vendor.
- Earthing material required for earthing of CCTV equipment installed by Vendor.
- Necessary base frame support for mounting CCTV cabinets in main control room.
- Any other item necessary but not specifically listed for successful operation of CCTV system.
- Packing, forwarding, transportation and storage at site of complete CCTV system and accessories.
- Supply of special instrument or tools needed for testing, calibration and maintenance of offered CCTV system.
- Supply of consumables and commissioning spares as per requisition for CCTV system.
- Any other item or/and activity not listed/indicated specifically but necessary for successful operation of CCTV system.
- CCTV monitoring of the site & image capture in case of an intrusion
- Future hardware expansion facility.
- The CCTV system shall be support high resolution viewing & recording.
- The images shall be transferred to a central location or on Mobile using Internet connectivity.
- The System shall be CE & FCC certified
- Complete system shall be from the same manufacturer.
- System should be design to work on low bandwidth WAN with following considerations:
  - 1) Camera stream : H.265
  - 2) Camera resolution : 4CIF (704x480)
  - 3) Video quality : Medium
  - 4) Number of cameras : 01
  - 5) Frame rate per camera at site :25FPS
  - 6) Frame rate per camera at Centre :15FPS
  - 7) Recording type : Continuous 24 Hours per day
  - 8) Desired days of storage per camera : 30 Days

All cameras should support dual stream and configured in such a way that one stream should provide feed to central control centre and other stream should be capable to support edge recording (memory card on camera or NVR). System should be intelligent to monitor WAN and whenever there is outage or central control centre not reachable camera should start recording on memory card or NVR present on camera and capable to restore the data to the central system in the missing area.

#### **4. SCOPE OF SERVICE :**

- Installation, integration of complete CCTV system and associated accessories including calibration, cabling, junction boxes, power supply, distribution boxes, etc.
- Installation of CCTV Cameras. The Cameras to be mounted on top of Pole, so as no blind spot is created due to pole.
- Installation of CCTV monitors for monitors located in main control room and monitors located in security control room (gate / security house).
- Installation of monitor located in MCR and security control room.
- Installation of mounting poles wherever applicable.
- Installation of CCTV cabinets for various units.
- Installation of programming unit PC.
- Installation of various junction boxes (signal, power, control) supplied by vendor.
- Laying of co-axial / optical fiber cable between CCTV Camera & Control Console Cabinets.
- Laying of power cable between CCTV Cameras and CCTV Cabinet in MCR.
- Laying of CCTV Cables (video, control, data, power).
- Laying of CCTV fiber optic Cables between MCR and security control room.
- Termination, ferruling and glanding at both ends and interconnection of various cables (video, optical, control, power) supplied by vendor for complete CCTV system.
- Distribution of power supply and reduction to required levels to various CCTV equipment supplied by vendor.
- Integration of CCTV Camera with BRPL Network

The entire IP surveillance system to be designed to control and monitor the locations provided based on following considerations:

- Camera to be of 4 MP (all to be integrated in the VMS present and future)
- CCTV system should be design to work on WAN with at lower bandwidth as low as (256Kbps per camera). Objects or persons should be identified under low bandwidth Scenario
- Bandwidth should be configurable



- System should be design to work and record on 15fps and 1 MP centrally
- System should be design with event based and continuous recording as and when required

Four types of cameras shall be considered to monitor the movement of the people as follows:

- 1) Indoor
  - 2) Outdoor
  - 3) PTZ
  - 4) 360 degrees outdoor
- All cameras shall be True Day/Night function IP camera
  - Analytics to be in built at camera side like – Face capture, Trip Wire, Counter, Object removal, Motion detection.
  - All accessories with the outdoor cameras like JB's, power supply, media converter etc. should be in water proof and dust proof housing
  - All cabling including LAN network will be in scope of vendor in case of open through ISI mark PVC / GI pipes or concealed through ISI mark PVC / HDPE pipe
  - L2 POE Cisco switches should be used to power-up the camera in case of 4 or more at a location else power adapter to be used to power up the cameras
  - Servers should be either HP / IBM
  - Servers should be planned in redundancy

## **5. TESTS.**

All equipment with their terminal connectors, and other hardware etc., shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with Latest Relevant IS .

## **6. COMPLETENESS OF EQUIPMENT:**

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

## **7. PACKINGS:**

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

**Note: All critical areas/rooms to be covered fully leaving no grey area. Placement of cameras shall be such that there should be no shadow portion.**

**TECHNICAL SPECIFICATION**  
**FOR**  
**FIRE DETECTION AND ALARM SYSTEM**

<b>Prepared by</b>				<b>Rev: 0</b>
<b>Reviewed by</b>				<b>Date:</b>
<b>Approved by</b>				

## Technical Specification Fire Detection and Alarm System

### 1.0 INTENT OF SPECIFICATION:

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport FOR site of Fire and smoke Detection & Alarm System for substation control room building complete with all materials and accessories for efficient and trouble free operation.

In the even of any discrepancy with the listed documents, the stipulation of this specification shall govern.

### 2.0 SCOPE OF WORK

#### 2.1 Scope of Supply

The following equipment shall be furnished with all accessories :-

- a) Smoke and heat detectors and installation.
- b) Manual call point for the substation building.
- c) Fire detection alarm panels which shall be SCADA compatible along with its integration with SCADA.
- d) All wiring & accessories to complete the installation.
- e) All installation hardware.
- f) All relevant drawings, data & instruction manuals.

### 3.0 GENERAL REQUIREMENT

#### 3.1 Codes and Standard

All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards except where modified and/or supplemented by this specification.

Equipment and materials conforming to any other standard which ensures equal or greater quality may be accepted. In such case copies of the English version of the standard adopted shall be submitted along with the bid.

In particular, the following standards and specifications are applicable.

Indian Electricity Rules	Relevant safety regulation of CEA
Indian electricity act	
CBIP manual	
IS 2189	Code of practice for selection, installation & maintenance of automatic fire alarm system.
IS 2190	Selection, installation & maintenance of first aid, fire extinguisher.
IS 1646	Tariff Advisory Committee Manual
	Code for practice for fire safety of buildings

**Technical Specification Fire Detection and Alarm System**

This specification shall be read and constructed in conjunction with the bid documents and annexure to determine the scope of work.

**4.0 DESIGN CRITERIA**

General	<ol style="list-style-type: none"> <li>1. The fire detection system shall consist of various types of fire detectors, control cabling, fire alarm panels, central monitoring station, annunciation/control panels, local panels.</li> <li>2. The fire detection and alarm system shall be microprocessor based, analogue addressable system.</li> <li>3. A central monitoring system shall be provided in the control room covering complete substation.</li> <li>4. The control system shall be compatible to be interfaced with SCADA system through separate communication port.</li> </ol>
Location	Fire detectors shall be provided for the entire substation building including control room, switchgear room, battery charger, corridors, Cable Celler etc. Fire detectors shall be located at strategic location in various rooms of the building.
Operation	<p>The operation of any of the fire detectors / manual call point should result in the following :</p> <ol style="list-style-type: none"> <li>a) A visual signal exhibited in the alarm panel indicating the area where the fire is detected.</li> <li>b) An audible alarm (Hooter) sounded in the panel.</li> <li>c) An external alarm sounded in the building, location of which shall be decided during detailed engineering.</li> <li>d) An alarm should be signaled to the control room.</li> </ol>
Detection & Alarm system	<ol style="list-style-type: none"> <li>1. Each zone shall be provided with two zone cards in the panel so that system will remain healthy even if one of the cards become defective which shall be indicated at SCADA .</li> <li>2. The control panel shall be suitable for 230V AC and 220V DC as power supply.</li> </ol>
Cabling	The detector cable and the other control cable shall be armoured, screened and twisted FRLS type in external areas and shall be of unarmoured FRLS type inside building (in conduits)
Tests	<p>All equipment shall be completely assembled wired, adjusted and routine tested at the factory as per relevant standards.</p> <p>Following tests shall be performed on the system</p> <ol style="list-style-type: none"> <li>a) Response characteristics of fire detectors.</li> <li>b) Performance test on fire extinguisher as required in the code.</li> <li>c) A comprehensive visual and functional check for the fire alarm panel.</li> <li>d) Verification of wiring as per approved schematic.</li> <li>e) Testing of fire detection panel as per BS3116 Part IV.</li> </ol>
Site Test	All the detectors installed shall be tested for actuation by bringing a suitable smoke source near the detector creating a stream smoke over the detector. After each test smoky atmosphere should be cleared so that the detector shall reset.

### Technical Specification Fire Detection and Alarm System

	Certify proper operation of all detectors and call points.
	One of each type of extinguisher shall be tested for its performance.

### 5.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.

**TECHNICAL SPECIFICATION**  
**FOR**  
**PACKING & TRANSPORTATION**

<b>Prepared by</b>			<b>Rev: 0</b>
<b>Reviewed by</b>			<b>Date:</b>
<b>Approved by</b>			

## Technical Specification Packing and Transportation

### 1.0 PACKING AND TRANSPORTATION

- 1.1 Packing shall be sturdy and adequate to protect all assemblies, components and accessories from injury by corrosion, dampness, heavy rains, breakage and vibration encountered during transportation, handling and storage at the plant site. All accessories, which are likely to get damaged during transit if transported mounted on the equipment, shall be removed, adequately packed and shipped separately. All openings shall be sealed. Spare parts shall be packed separately and clearly marked. They shall be specially packed for long storage without injury.
  - 1.2 The bidder shall after proper painting, pack and crate all plant equipment for sea shipment/air freight in a manner suitable for export to a tropical humid and saline air borne climate region as per Internationally accepted export practice in such a manner so as to protect it from damage and deterioration in transit by road, rail and/or sea and during storage at site till the time of erection. The bidder shall be held responsible for all damages due to improper packing.
  - 1.3 The bidder shall give complete shipping information concerning the weight, size, contents of each package including any other information the Owner may require. The weight and size of the package shall be such that they can be easily transported from the maker's works to the plant site by ship/air, road ways and railways.
  - 1.4 The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, overhead lines, free access etc. from the manufacturing plant to the project site; and furnish to the Owner confirmation that the proposed packages can be safely transported, as normal or oversize packages, upto the plant site. Any modifications required in the infrastructure and cost thereof in this connection shall be done and borne by the bidder.
  - 1.5 The bidder shall prepare detailed packing list of all packages and containers, bundles and loose materials forming each and every consignment dispatched to 'site'. The bidder shall further be responsible, for making all necessary arrangements for loading, unloading and other handling right from his works; and from Indian port for equipment under the Off-shore Supply till the 'site' and also till the equipment is erected, tested and commissioned. The bidder shall be solely responsible for proper storage and safe custody of all equipment.
  - 1.6 All packages must be marked consecutively from number one upwards covering all shipments until completion of the plant equipment execution without repeating the same number. Each box, crate, case bundle or each piece of lose material shall be painted with a combination of one white band and one yellow band of a least 4 cm wide each, round the body of the box, crates, etc as the case be for easy identification.
- 2.0** GPS instrument must be installed for proper tracking of material during transit of major equipment like Transformer, GIS Panel, 11KV & 66 KV panels etc. of MAP my india make (asset tracking system)
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## Technical Specification Packing and Transportation

### 3.0 DEVIATIONS

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.



**TECHNICAL SPECIFICATION**

**FOR**

**MATERIALS WORKMANSHIP & TEST**

<b>Prepared by</b>				<b>Rev: 0</b>
<b>Reviewed by</b>				<b>Date:</b>
<b>Approved by</b>				

## Technical Specification Materials Workmanship and Tests

### 1.0 MATERIAL, WORKMANSHIP & TESTS

#### 1.1 General

All materials used in the manufacture of the offered plant equipment shall be of high grade, free from defects and imperfections, of recent manufacture and unused. Materials not specifically described elsewhere, shall as far as applicable and practicable conform to the latest specification of ISS where applicable and equivalent International Standards. Liberal factors of safety shall be used throughout the design for all parts of plant equipment when subjected to the most severe operating conditions. The working stress in all parts of the plant equipment shall be bestowed with ample margins for possible overstressing due to shock.

All work shall be performed and completed in accordance with the best modern shop practice in manufacture of high grade equipment.

Castings shall be free from blow-holes, flaws, cracks or other defects; and shall be smooth, close-grained and of true form and dimensions. No plugged or filled-up holes or other defects will be accepted. No casting shall be burned, plugged, patched or welded; and no repairs or defects will be accepted.

All materials, supplies, parts and assemblies supplied under this specification shall be tested as far as reasonably practical.

All welded joints shall be free from defects such as blow-holes, slag inclusions, lack of penetrations, under-cuts, cracks etc; and shall be made by qualified and tested welders. Slag shall be ground after joint completion; and well reinforced smooth welds shall be made.

#### 1.2 Inspection, Testing program and Notification

Before manufacture commences, the contractor shall submit an outline of the proposed inspection and testing programmes (Quality Assurance Programme - QAP) for all major stages during manufacturing of major equipment. This inspection and testing programme shall include for the various items, the designation number, the kind of test, test standard and the extent of witness by the Owner/Engineer or third party.

The notification of the individual witness inspections made by the Owner/Engineer or the third party, shall be given by the contractor using facsimile or telex or e-mail in a format to be agreed upon. The contractor shall notify the Owner/Engineer within 21 days prior to the date on and the place at which item shall be ready for testing. If any postponement becomes necessary, the contractor shall provide written notification of same at least 72 hours prior to the originally scheduled date.

If the Owner/Engineer does not attend the test at the place and at the date which the contractor has stated in his notification, the contractor shall proceed with the test, which shall

## Technical Specification Materials Workmanship and Tests

be deemed to have been made in their presence and shall forthwith forward to them duly certified copies of the test readings.

Before erection commences, the contractor shall submit an outline of the proposed erection inspection and test programme during the erection of major systems. The individual testing procedure shall be submitted as progress of erection work of the equipment, systems and/or units, coordinated with relevant work of the complete plant.

Before commissioning commences, the contractor shall submit an outline of the proposed commissioning test procedure. The test programmes shall be maintained by the contractor during erection and commissioning.

### 1.3 Test : General

During manufacture, the Owner's representative shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the contractor's and his sub-contractor's plant system equipment and may reject any defective materials considered unsuitable for the intended purpose or which does not comply with the intent of this specification. The contractor, upon any such rejection by the Owner or his representative, shall rectify or replace the defective or unsuitable material. The contractor shall provide every reasonable inspection facility to the Owner's inspector or representative at his own and his sub-contractor's works.

Material being furnished against this order shall only be shipped when factory inspection satisfactory to the Owner and/or his representative has been conducted. Such inspection and acceptance for shipment shall not however, relieve the contractor from entire responsibility for furnishing the plant system equipment conforming to the requirement of this specification nor shall prejudice any claim, right or privilege which the Owner may have, because of the use or supply of defective or unsatisfactory materials for the plant system equipment. Should the inspection be waived by the Owner, such waiver shall not also relieve the contractor in any way, from his entire obligations under this order.

The plant system equipment shall at factory or after installation be demonstrated capable of performing satisfactorily upto the contractor's guaranteed performance. All tests required by this specification, including retests and inspection, that may be necessary owing to failure to meet any tests specified, shall be made at the contractor's expense. Additional tests, as necessary, shall be made to locate any such failure and after determining the causes of failure and rectifying it, specified tests shall be repeated to establish that the rebuilt plant system equipment meets with the specification in every respect. Should the equipment ultimately fail to pass the tests specified, the Owner will have the option to reject the unit.

The bidder shall state in the proposal, the shop testing facilities available. Should full capacity testing equipment be not available, the bidder shall state the method proposed to be adopted with detailed computations and justification for adopting such a method to reliably ascertain the equipment characteristics corresponding to full capacity testing.

### 1.4 Test Certificate

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## **Technical Specification Materials Workmanship and Tests**

In accordance with approved QCP, the results of the tests shall be certified by the Owner/Engineer or independent agency as applicable. As and when the item of the plant equipment has passed the tests, the Owner/Engineer shall furnish to the contractor a certificate in writing to that effect. The Quality Control Plan (QCP) shall be issued by the contractor within 1 months after NTP. Document files containing material certificates, test reports, etc shall be compiled for each QCP item of plant equipment; and shall be suitably identified (including equipment classification reference) and bound. Copies of compiled file shall be submitted as per distribution schedule

### **1.5 Tests at Manufacturers Works**

The major equipment of the plant to be supplied under this contract shall be subjected to shop inspection and tests. After NTP, the contractor shall issue within 1 months a QCP indicating the kind and extent of inspection and tests to be carried out on the offered plant equipment components to prove whether the equipment fulfills the requirement of the contract in view of:

- Safety Conditions
- Consideration of the applied standards and regulations
- Execution of workmanship

### **SITE TESTS**

Tests conducted at sites shall be indicated by bidder.

### **2.0 DEVIATIONS**

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.

**TECHNICAL SPECIFICATION**  
**FOR**  
**MISCELLANEOUS ACTIVITIES**

<b>Prepared by</b>				<b>Rev: 0</b>
<b>Reviewed by</b>				<b>Date:</b>
<b>Approved by</b>				

## **Chapter 6b Technical Specification Misc Activities**

### **1.0 SERVICE AFTER SALES**

- 1.1 The bidder shall furnish in detail about his organization for rendering service after sales, covering deployment of personnel and supply of spares, for ensuring efficient operation and maintenance of the offered plant equipment. The details of spares and service facilities possessed by them should be elaborated.
- 1.2 The bidder shall guarantee furnishing of the following in respect of after sales services including spares:-
- i) Providing services of his specialists on indent from the Owner for periodical or special maintenance of the plant; as well as for identifying sources of trouble, if any, reported and measures for immediate rectification.
  - ii) The bidder shall guarantee maintenance of adequate spares at his works to be supplied on indent from the Owner at short notice during the life of the plant.

### **2.0 BID DATA, DRAWINGS AND INFORMATION REQUIRED**

- 2.1 Technical data sheets, drawings, schedules with supporting information incorporating the details in compliance to spec but not limited to the following shall be furnished along with the proposal:
- 2.2 Duly filled in 'Schedule of Guaranteed and other Technical Particulars Schedules 'C' except for data which cannot be finally furnished with the Bid. The Price and Delivery Schedule-B duly filled in.
- 2.3 Dimensioned outline drawings of the offered overall plant and separately for equipment including cross-sectional drawings showing dimensions, net weights, shipping weights and suggested arrangement layout of proposed plant & equipment with auxiliaries etc. Technical Literature/leaflets of the above plant equipment.
- 2.4 Manufacturers' catalogues showing the construction details of various equipments should be furnished indicating clearly the technical preference of the offered equipment over the specified equipment.
- 2.5 List of users of comparable plant equipment with the year in which the Diesel plant and other critical plant equipment was put actually into service. For technical acceptability of the bid, proven experience of the bidder in manufacture and satisfactory and trouble free performance of the critical plant equipment for at least three (3) years is essential for which the bidder shall furnish necessary documents in support of the above.
- 2.6 A bar chart of design, engineering, procurement, manufacture, testing, delivery, installation, commissioning and site testing including civil structural and architectural works of the proposed plant equipment.
-

## **Chapter 6b Technical Specification Misc Activities**

- 2.7 Technical description of the proposed plant equipment and materials particularly outlining any additional list out features proposed for safety & reliability. List out items of work & services not included and which has to be provided by the Owner for satisfactory commissioning of the offered plant equipment supplied.
- 2.8 The bid shall not be considered if the bidder fails to submit all the details asked for. Proposal should be complete without ambiguity and should be clearly written against each item.
- 2.9 Bidder shall furnish Quality Assurance Programme for design, manufacture, assembly, erection, testing & commissioning including civil, structural and architectural works along with the proposal for all equipment covered under this specification whether manufactured by the bidder or procured from other sources.
- 2.10 Technical deviations from the specification, if any, shall be clearly listed in the Schedule-E. In absence of any deviation given in Schedule-E and accepted by Owner, it will be bidder's responsibility and his contractual obligation to supply the Plant equipment as per specification to Owner/Engineer's approval.
- 2.11 List of shop and site tests, the bidder proposes to carry out including those pertaining to their sub-suppliers works shall be clearly brought out in Schedule – G. In addition to above tests, the bidder shall conduct any other tests, to Owner/Engineer's approval, which are considered important for satisfactory operation of plant equipment.
- 2.12 Bidder shall furnish all required mandatory and startup commissioning spare parts as well as maintenance tools and tackles with unit prices for the offered plant equipment.

## **3.0 POST CONTRACT DATA AND DRAWINGS**

- 3.1 The contractor shall submit within thirty (30) days from the date of the order and Notice to Proceed (NTP) certified dimensioned drawings and technical schedules giving every detail of the offered plant equipment particularly the following:
  - 3.2 Completely filled in schedule of guaranteed particulars and other technical particulars.
  - 3.3 Single line diagrams; logic diagrams, dimensioned general arrangement and equipment layout drawings showing front and side elevations, plan and sectional views of the offered equipment forming part of the contractor's supply; The drawings should also indicate structures & supporting details including foundation outline and loading data etc.
  - 3.4 Final version of all drawings and data submitted along in the proposal mentioned above.
  - 3.5 Structural, thermodynamic and pressure part calculations showing compliance with specifications and codes as and when required.
  - 3.6 Any other drawings/details not specified herein and required by the Owner/Engineer to correctly coordinate the offered plant equipment with other contractor's work.
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## **Chapter 6b Technical Specification Misc Activities**

- 3.7 Civil design calculations.
- 3.8 Detailed specifications and data sheets of the plant equipment with auxiliaries.
- 3.9 Detail drawings of critical equipment units, assemblies, parts etc. as deemed necessary.
- 3.10 Design calculations of conductor sizing, cable sizing, main equipment sizing etc.
- 3.11 Schematic wiring diagrams along with write-ups for control, interlocks, instrumentation, protection, circuits. Terminal blocks and terminals arrangement drawings showing power & control cable connections.
- 3.12 Owner/Engineer will return to the contractor one (1) print of each drawing either.
  - (a) stamped approved or (b) marked up with the comments. In case of (a), no further submission of a drawing will be required. In case of (b), the contractor shall correct his original drawings to conform to comments made by the Owner/Engineer and resubmit within two (2) weeks of receipt of comments in the same manner as stated in the Distribution Schedule. The Owner/Engineer's approval shall not relieve the contractor from any of his obligation and responsibility to manufacture and supply equipment conforming to this specification, unless a written amendment to the specification is issued by the Owner.
- 3.13 After approval of the drawings, reproducible of each drawing shall be supplied. Final drawings shall be certified as Approved for Construction. Should any minor revision be made after approval the contractor shall re-distribute 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 drawing.
- 3.14 Reproducible shall be of quality to produce clear and legible prints and any inferior reproducible will be returned by the Owner 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 unfolded in envelope with a cardboard backing. The prints and reproducible shall be mailed in the most expeditious manner and shall be accompanied with a letter of transmittal.

## **4.0 INSTRUCTION MANUAL**

- 4.1 At least one (1) month prior to the dispatch of the plant equipment, fifteen (15) copies of installation, testing and adjustments after installation, operation and maintenance manuals shall be furnished. These manuals shall be sturdily bound volumes and shall contain every drawings and information required for installation, testing, setting and adjustment of all components after installation, operation and maintenance of the equipment and all its components. Separate tabs shall be used for such instructions concerning each equipment control components, electrical and other accessories. The other data needed for servicing the components and ordering their spare parts.
-



## Chapter 6b Technical Specification Misc Activities

- 4.2 Marked erection prints identifying the components parts of the equipment, as transported, with its assembly drawings.
- 4.3 Detailed dimensioned assembly and cross sectional drawings and description of all the plant system equipment with auxiliaries and drawings identifying all spare parts for re-order.
- 4.4 Documentation

Correspondence, drawings, progress reports, schedules, tests reports and instruction manuals shall be mailed in requisite copies in accordance with Distribution Schedule.

## 5.0 WORK SCHEDULE

- 5.1 Time being the essence of the proposal, preference will be given for the offers quoting earlier deliveries. The bidder shall include in his proposal his programme for furnishing and erecting the offered plant & equipment.
- 5.2 The programme shall be in the form of master network identifying the key phases in various areas of total plant work, such as design work, procurement of raw materials, manufacture of components & subassemblies; complete erection of equipment and all other field activities. The master network shall conform to completion of trial operation from the date of Letter of Award within a period of 4 months. The trial operations shall commence any day within 15 days prior to the date of completion indicated above.
- 5.3 This master network shall be discussed and agreed before the issue of letter of award. Engineering drawings as well as technical data sheets submission schedule shall also be discussed and finalized before the issue of letter of award. Provisions of the liquidated damages leviable for delays in completion of trial operation shall become effective after the above mentioned date.
- 5.4 After the contract award, the contractor shall plan the sequence of work of manufacture and erection including associated civil works to meet the Owner's power plant commissioning requirements; and shall ensure that all work/manufacture, shop testing, inspection & shipment of the equipment in accordance with the required construction/erection sequence.
- 5.5 Within seven (7) days of acceptance of the letter of award, the contractor shall submit, for review and approval, two copies (1 reproducible and 1 print) of Detailed Network schedules, based on the Master Network (mutually agreed by the Owner & contractor) to the Owner/Engineer showing the logic & duration of the activities in the following areas
  - i) Engineering, Procurement, Manufacturing & Supply Detailed engineering activities in regard to procurement of raw materials including bought out items, manufacture, dispatch/ shipment & receipt at site.
  - ii) Civil, Structural & Architectural Works:  
  
Detailed engineering activities in regard to civil & structural works execution based on the offered equipment and approved drawings including detailed execution of execution activities covering the complete scope of work.
  - iii) Erection, Testing and Commissioning:

## Chapter 6b Technical Specification Misc Activities

Detailed erection, testing and commissioning activities, covering the complete scope of work of the offered plant equipment coordinated with the civil and structural works executed.

### 5.6 Detailed Manufacturing Program

Detailed manufacturing PERT/PRIMAVERA programme for all the manufacturing activities of the offered plant equipment at contractor's/subcontractor's works shall be furnished within 7 days of letter of award.

The manufacturing network shall be supported by detailed procurement programme for critical bought out items/raw materials

Pre-erection Activity Programme

- A) Manpower Deployment
- B) Tools and plant mobilization plan
- C) Detailed Site Mobilization Plan

5.7 Within a week of approval of the Network schedule, the contractor shall forward to the owner/Engineer copies of the Computer initial run data in an acceptable manner

5.8 The network shall be updated every month; or as frequency as possible to mutual agreement. Within seven (7) days following the monthly review, a progress meeting shall be held at the work (possible) wherein the major items of the plant or equipment are being produced. The meeting will be attended by the Owner/Engineer and responsible representatives of the contractor. The contractor shall be responsible for minuting the proceedings of the meeting, a report of which shall reach the Owner or the Owner/Engineer not later than 7 days following the meeting.

5.9 Access to the contractor's and/or sub-contractor's work shall be granted to the Owner/Engineer at all reasonable times for the purpose of ascertaining the progress

## 6.0 PROGRESS REPORTS

During execution of the contract either in manufacture or erection/commissioning, the contractor shall furnish monthly progress report to the Owner or the Owner/Engineer in a format as specified indicating the progress achieved during the month, and total progress upto the month as against scheduled and anticipated completion dates in respect of key phase of work or manufacture and shipment such as release of drawings for fabrication, procurement of raw materials, inspection and testing. If called for by the Owner/Engineer, the contractor shall also furnish to the Owner or the Owner/Engineer resources data in a specified format and time schedule. The contractor shall also furnish any other information necessary to ascertain progress if called for by the Owner/Engineer

## **Chapter 6b Technical Specification Misc Activities**

### **7.0 DEVIATIONS**

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification.



# Specification for 66kV SOLIDCORE POST INSULATORS

Specification no. GN101-03-SP-49-00

Prepared by:		Checked by:		Approved by:		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
Tanu		Meenakshi		K.K.Alla		00	31-July-14

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## General Specification

### 1.0 CODES & STANDARDS:

Materials, equipment and methods used in the manufacture of Solid core post insulators shall conform to the latest edition of following –

#### National/International Standard

Standard Code	Standard Description
IS - 2544	Porcelain post insulators for system with nominal voltage greater than 1000 V
IS - 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IEC - 62231	Composite station post insulators for substation with a.c. voltages greater than 1000 V upto 245 kV
IEC - 60273	Characteristic of indoor and outdoor post insulator for system with nominal voltage greater than 1000V
IEC - 60168	Tests on indoor & outdoor post insulators of ceramic material or glass for system with nominal voltage greater than 1000V
IEC - 60815	Selection and dimensioning of High voltage insulators for use in polluted conditions

The electrical installation shall meet the requirement of Indian Electricity Rules as amended upto date, relevant IS code of practice and Indian electricity act. In addition other rules & regulations applicable to the work shall be followed. In case of any discrepancy the most stringent & restrictive one shall be binding

### 2.0 MAJOR DESIGN CRITERIA

	Description	Requirement / Rating
2.1.0	System	66KV
2.1.1	Voltage	66KV $\pm$ 10%
2.1.2	Frequency	50HZ $\pm$ 5%
2.1.3	Fault level	31.5KA for 3secs.

2.1.4	Type	<ul style="list-style-type: none"> <li>i) Post insulators for substation shall be of outdoor type suitable for operation under tropical condition with high temperature, humidity and rainfall.</li> <li>ii) Porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed</li> <li>iii) Unless otherwise specified, the glaze shall be brown in color. The glaze shall cover all the porcelain parts of the insulators except those areas, which serve as supports during firing or left unglazed for the purpose of assembly.</li> <li>iv) 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. Shape of the insulator should be such that it facilitates easy cleaning by normal methods.</li> </ul>
2.1.5	Protection against Corrosion	All malleable iron steel work, steel bolts and nuts and flanges shall be hot dip galvanized in accordance with IS:2629 with latest amendment thereof.

### 3.0 QUALITY ASSURANCE

3.1	Vendor quality plan	To be submitted for purchaser approval.
3.2	Inspection point	To be mutually identified and agreed in quality plan.

### 4.0 PROGRESS REPORTING

4.1	Out Line Document	To be submitted for purchase approval for outline of production, inspection, testing, inspection, packing, dispatch, documentation programme.
4.2	Detailed Progress Report	<p>To be submitted to purchaser once a month containing</p> <ul style="list-style-type: none"> <li>i) Progress on material procurement</li> <li>ii) Progress on fabrication (As applicable)</li> <li>iii) Progress on assemble (As applicable)</li> <li>iv) Progress on internal stage inspection</li> <li>v) Reason for any delay in total programme</li> </ul>

		<ul style="list-style-type: none"> <li>vi) Details of test failures if any in manufacturing stages</li> <li>vii) Progress on final box up constraints / Forward path</li> </ul>
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## 5.0 DRAWING, DATA & MANUALS

5.1.0	To be submitted along with bid	<p>Seller has to be submitted :</p> <ul style="list-style-type: none"> <li>i) Tentative GA /cross sectional drawing of product showing all the views / sections</li> <li>ii) Detailed reference list of customers already using the offered product during the last 5 years with particular emphasis on units of similar design and rating</li> <li>iii) Completely filled GTP</li> <li>iv) Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.</li> <li>v) Details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification</li> <li>vi) Type test report from CPRI/ERDA shall be submitted for the type , size &amp; rating of product / equipment offered along with bid in case the type test report for identical product is not available then type report of higher size / rating shall be submitted for review. They shall be considered valid 5 years from date of test.</li> <li>vii) Complete product catalogue and manual along with the bid.</li> <li>viii) Recommended spare parts and consumables items for 5 years of operation with prices and spare parts catalogue with list for future requirements.</li> </ul>
5.2.0	After award of contract, seller has to submit mentioned drawings for buyer's Approval (A ) / Reference	<ul style="list-style-type: none"> <li>i) Programme for production and testing (A)</li> <li>ii) Guaranteed Technical Particulars (A)</li> </ul>



	(R)	<ul style="list-style-type: none"> <li>iii) Calculations to substantiate choice of electrical , structural , mechanical component size / ratings (A)</li> <li>iv) Detailed dimensional drawing for all components, general arrangement drawing showing detailed component layout and the detailed schematic and wiring drawings for all components (like marshalling box)</li> <li>v) Terminal arrangement &amp; cable box details etc. (as applicable) (A)</li> <li>vi) Drawing for major components (A)</li> <li>vii) Rating &amp; Diagram plate (A)</li> <li>viii) Detailed loading drawing to enable the buyer to design and construct foundations (as applicable ) (R)</li> <li>ix) Transport / Shipping dimensions with weights, wheel base details, untanking height etc. (As applicable ) (R)</li> <li>x) List of makes of all fittings and accessories (A)</li> <li>xi) Detailed installation and commissioning instructions ( R)</li> <li>xii) Quality plan</li> </ul>
5.3.0	Submittals required prior to dispatch	<ul style="list-style-type: none"> <li>i) Inspection and test reports, carried out in manufacturer's work ( R )</li> <li>ii) Test certificates of all bought out items</li> <li>iii) Operation and maintenance instruction as well as trouble shooting chart / manuals.</li> <li>iv)</li> </ul>
5.4.0	Drawing and document size	Standard size paper A0, A1 , A2, A3, A4
5.5.0	No of drgs./Documents required at diffderent stages	As per Annexure A scope of supply

## 6.0 INSPECTION & TESTING

6.1.0	Inspection and Testing during manufacture	
6.2.0	Routine tests	Tests shall be carried out in accordance with IS 2544

6.3.0	Type Tests	<ul style="list-style-type: none"> <li>a) On one post insulator of each rating and type tested from CPRI/ERDA, reports to be submitted.</li> <li>b) All the test as per IS 2544</li> <li>c) In case the product is never type tested earlier, seller has to conduct the type tests from CPRI/ERDA test labs on BSES order at their own cost, before commencement of supply.</li> <li>d) Power frequency withstand test to be carried out on selected sample at the time of acceptance test.</li> </ul>
6.4.0	Acceptance test	To be performed in presence of Purchaser at manufacturer works:- <ul style="list-style-type: none"> <li>i) Verification of dimensions</li> <li>ii) Temperature cycle test</li> <li>iii) Mechanical strength test</li> <li>iv) Puncture test</li> <li>v) Porosity test</li> <li>vi) Galvanising test</li> </ul>
6.5.0	Sampling	The number of post insulators or post insulator units to be selected at random from the lot for acceptance tests shall be in accordance with Table 3, IS 2544

## 7.0 PACKING , SHIPPING, HANDLING AND STORAGE

7.0.0	Packing	
7.1.1	Packing protection	Against corrosion , dampness, heavy rains, breakage and vibration
7.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection and identification labels.
7.1.3	Packing identification label	In each packing case, following details are required : <ul style="list-style-type: none"> <li>i) Individual serial number</li> <li>ii) Purchaser's name</li> <li>iii) PO number (along with SAP item code , if any) &amp; date</li> <li>iv) Equipment Tag no. (if any)</li> <li>v) Destination</li> <li>vi) Manufacturer / Supplier's name</li> <li>vii) Address of manufacturer's / supplier's its agent</li> <li>viii) Description and quantity</li> <li>ix) Country of origin</li> <li>x) Month and year of manufacturing</li> <li>xi) Case measurement</li> <li>xii) Minimum failing load in kg</li> <li>xiii) Gross and net weight in kilograms</li> <li>xiv) All necessary slinging and stacking instructions.</li> </ul>
7.1.4	Shipping	<ul style="list-style-type: none"> <li>i) The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as</li> </ul>

		<p>weights, dimensions, road culverts, overhead lines, free access etc. from the manufacturing plant to the project site, and furnish to the purchaser confirmation that the proposed packages can be safely transported, as normal or oversize packages, upto the plant site. Any modification required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.</p> <p>ii) The seller shall be responsible for all transit damage due to improper packing.</p>
7.1.5	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual need to be furnished before commencement of supply.

## 8.0 DEVIATIONS

Deviation from this specification shall be started in writing with the tender by reference to the specification clause/ DTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assured by the Buyer that the seller complies fully with this specification.

**Note: Bidder shall furnish MQP along with technical bid and shall submit required guaranteed technical particulars as per attached Annexure - C**

**Annexure –A            Scope of supply**

1.0     The scope of supply shall include following

- 1.1     Design, engineering, manufacture, assembly, testing at manufacture's works, packing, transportation and delivery to site, supervision of erection, testing at site & commissioning and submission of complete documentation.

<b>Sr. No.</b>	<b>Description</b>	<b>Scope of Supply</b>
1.0	Fully assembled solid core post insulators with all major parts	YES
1.2	Fixing Bolts for insulators	YES
1.3	Routine testing as per this specification	YES
1.4	Type testing as per this specification	YES
1.5	Submission of Documentation as detailed below	YES

1.2     Supervision of testing & commissioning of post insulators on site

1.3     BOQ as following-

<b>Sr. No.</b>	<b>Purchaser Equipment Tag No. / SAP code</b>	<b>Location / Substation name</b>	<b>Unit</b>	<b>Quantity</b>
1		e.g. Santacruz	No	e.g. 1
2		e.g. Alaknanda	No	e.g. 1
3				
4				
5				

2.0     Submission of documents

Submission of drawing, calculations, manual, catalogues, test report shall be as follows

	<b>Along with offer</b>	<b>For Approval after award of contract</b>	<b>Final after approval</b>	<b>Remarks</b>
Drawing	3 copies (Typical drgs)	4 copies	6 copies + 1 soft copy in CD	See clause 5.0 for various drawing required
Calculations	3 copies (Typical)	4 copies	6 copies + 1 soft copy in CD	See clause 5.0 for details
Catalogues	1 copy		6 copies + 1 soft copy in CD	
Instruction manual	1 copy		6 copies + 1 soft copy in CD	
Test Report	2 copy		6 copies + 1 soft copy in CD	Type test and sample routine test reports

**3.0 Delivery Schedule**

- 3.1 Delivery Period start date - from data of purchase order
- 3.2 Delivery Period end date - as agreed with supplier
- 3.3 Material dispatch clearance - after inspection by purchaser and written dispatch Clearance for purchaser

**Annexure – B SERVICE CONDITIONS**

2.0.0	Delhi Atmospheric conditions	
a)	Average grade atmosphere	Heavy polluted , dry
	Maximum altitude above sea level	1000 M
b)	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
	Maximum ambient air temperature	0 deg C
c)	Relative Humidity	100 % Max
d)	Thermal Resistivity of Soil	150 deg. C cm/W
e)	Seismic Zone	4 as per IS 1893
f)	Rainfall	750 mm concentrated in four months
g)	Wind Pressure	195 Kg/m <sup>2</sup> up to 90 M elevation as per IS 875-1975

**Annexure C: GURANTEED TECHNICAL PARTICULARS FOR 66 KV Solid Core Post Insulators**

<b>Sr. No.</b>	<b>Description</b>	<b>Data By Purchaser</b>	<b>Data By Supplier</b>
1.0	Highest system voltage	72.5 kV	
2.0	Height of unit	As per IS 2544 and IS 5350	
3.0	Bending Strength (min.failing load)	As per IS 2544	
4.0	Tensile Strength	As per IS 2544	
5.0	Compression Strength	As per IS 2544	
6.0	Torsion Strength	As per IS 2544	
7.0	Power frequency flashover voltage a.) DRY b.) WET	As per IS 2544 a.) 150kV b.) 140kV	
8.0	Impulse Flashover Voltage	325 kV	
9.0	One minute power frequency Voltage a.) DRY b.) WET	As per IS 2544	
10.0	Power frequency puncture voltage	As per IS 2544	
11.0	Visible discharge Voltage	As per IS 2544	
12.0	Creepage distance a.) TOTAL b.) PROTECTED	31 mm/kV	
13.0	Diameter of insulating part		
14.0	Top metal fitting pitch circle diameter (PCD)		
15.0	Bottom metal fitting pitch circle diameter (PCD)		
16.0	All ferrous parts hot dip galvanised (as per IS 2629)	YES	
17.0	Suitable for hot line washing	YES	

**Annexure –D RECOMMENDED SPARES (DATA BY SUPPLIER)**

List of recommended spares as following –

<b>Sr. No.</b>	<b>Description of spare part</b>	<b>Unit</b>	<b>Quality</b>
1			
2			
3			
4			
5			
6			





## **TECHNICAL SPECIFICATION**

**FOR**

## **CABLE SEAL SOLUTION**

Specification No- SP-GMS-01-R0

<b>Prepared by</b>	Javed Ahmed		<b>Rev: 1</b>
<b>Reviewed by</b>	Abhinav Srivastava		
<b>Approved by</b>	Sheshadri Krishnapura		<b>Date: 16<sup>th</sup> April 2022</b>

## Index

- 1.0 Scope
- 2.0 Basic Features
- 3.0 Service Conditions
- 4.0 System Design
- 5.0 Installation, Testing and Commissioning
- 6.0 Maintenance
- 7.0 Approved Makes.
- 8.0 Drawing and Data submission
- 9.0 Shipping
- 10.0 Handling and Storage
- 11.0 Quality
- 12.0 Deviation
- 13.0 Testing and Inspection
- 14.0 Training

## **1.0. SCOPE:**

This specification covers design, engineering, manufacture, assembly, stage testing, inspection & testing before supply & delivery at site and installation testing and commissioning including handover the system to BRPL after successful execution of Cable Seal Solution

This Scope includes the following

- a) Supply of Cable Seal System including its transportation to BRPL Site
- b) Installation testing commissioning of Cable seal solutions with all the accessories including minor civil work if any.

## **2.0. Basic Features:**

Following requirements shall be fulfilled and supported with valid test reports/certificates:

1. Minimum IP 65 Protection level Certificate for protection from Dust and Water.
2. Heat sink test report of Cable transit system.
3. Certificate/ Test Report for Protection from Rats and Rodents.
4. ATEX, PESO Approval for Explosive atmosphere.
5. NEMA Certificate as per UL 508A for the safety of Cabinets & Enclosures mandatory.
6. Material of Frame shall be of Stainless Steel.
7. System must have Bonding & grounding (Armour Earthing) feature as per IS 3043-1987 using a suitable Tin Plated Copper Braid to be used wherever required. It should be also tested for Impulse withstands as per IEC 62305-1 for minimum 50kA for 1 sec.
8. Manufacturer should have direct presence in India with all the after Sale & Service support from last 10 years.
9. Cable sealing system should have been tested for F- Rating Fire for 3 hrs as per UL 1479/ EN, Insulation and Integrity for 120 mins as mentioned in Indian National Building Code(EI 120) Certificate from BS 476 are mandatory.
10. Cable sealing system should have been tested for GAS tightness of 2.5 bar pressure.
11. EPDM modules in System must have Halogen content less than 200ppm with low smoke index-F1 Classification as per NF16-101 & NF16-102, Heat Radiation test in compliance with M2 classification, UV Ageing Test as per ISO-4892-2:2006 & ISO-815- 1:2008, Oxygen Index Test as per ASTM D 2863-00, Shock & Vibration Test as per NES 510.
12. System must have Bonding & grounding (Armour Earthing) feature as per IS 3043-1987 using a suitable Tin Plated Copper Braid to be used wherever required. It should be also tested for Impulse withstand as per IEC 62305-1 for minimum 50kA for 1 sec.
13. Smoke Index shall be low. Type test reports for the same shall be provided by the supplier.
14. Shelf life of module - 25 Years
15. Solubility – Insoluble in water.

### 3.0. SERVICE CONDITIONS:

S.No	Particulars	Data
1	Design Ambient temperature	0°C to 50 °C
2	Seismic Condition	Zone IV as per IS 1893
3	Wind Pressure	195 kg/M <sup>2</sup> upto elevation of 30 M as per IS 875
4	Maximum Relative Humidity	100%
5	Maximum Altitude above Sea level	1000M
6	Rainfall	750mm (concentrated in 4 months)
7	Pollution level	Heavy/Dry
8	Average of no thunderstorm days	40 per annum

### 4.0. SYSTEM DESIGN

1. Modules with concentric peel able/removable layered multi-diameter cable sealing system consisting of frames, blocks and accessories shall be installed where the cables enter or leave any type of Electrical Panel/Cabinet/Transformer cable box. Each concentric module shall have a minimum of 10 mm range between smallest and largest adaptable diameter. System should be designed with minimum +/- 3 mm design margin. System should have provision for usable spares of 30% with no loose/ hanging / add layer / plug in type or to be stored components of modules / seals, each spare module should be concentric peelable/removable multi-diameter layered with complete range installed on Frame and solid Block are not acceptable..
2. It Shall cover following openings

For all Cable entry from outside to control room building and between room to room

### 5.0. MAINTENANCE

Bidder shall furnish a maintenance manual and support maintenance activity.

### 6.0. APPROVED MAKES

Roxtec, MCT Brattberg

### 7.0. APPROVED MAKES

8.1	Submissions along with the bid	
8.1.1	Duly filled GTP and copy of	2 copies + 1 soft copy

	specification	
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## 8.0. SHIPPING

9.1	Shipping	<p>The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, Overhead lines, free access etc. from the Manufacturing plant to the project site. Bidder shall furnish the confirmation that the proposed Packages can be safely transported, as normal or oversize packages, up to the site.</p> <p>Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser.</p> <p>The Bidder shall be responsible for all transit damage due to improper packing.</p>
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## 9.0. HANDLING AND STORAGE

10.0	Handling and Storage	<p>Manufacturer instruction shall be followed. Detail handling &amp; storage instruction sheet / manual needs to be furnished before commencement of supply.</p>
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## 10.0. QUALITY

11.1	Vendor quality plan	To be submitted for purchaser approval
11.2	Inspection points	To be mutually identified & agreed in quality plan

## 11.0. DEVIATION

12.1	Deviation	<p>Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that</p>
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		the bidder complies fully with this specification. No deviation will be acceptable post order.
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**12.0. TESTING AND INSPECTION**

Shall be as per latest relevant standards

**13.0. TRAINING**

Training on installation, commissioning, operation and maintenance shall be included in the proposal.

- at factory/site- 1 Manday

**TECHNICAL SPECIFICATION**  
**SPARES MAINTENANCE TOOLS AND**  
**TACKLES**

<b>Prepared by</b>	<b>Javed Ahmed</b>		<b>Rev: 1</b>
<b>Reviewed by</b>	<b>AS</b>		<b>Date: 11.07.2018</b>
<b>Approved by</b>	<b>KS</b>		

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## Volume-1 Technical Specification for Spares and maintenance tools and tackles

**1.0 Spares Requirement:** Following Spares shall be supply shall be in scope of Vendor for each package in addition to spares mentioned in individual equipment specifications, however in case of duplicacy/repetition only once shall be considered with quantity most stringent one quantity.

1. Spare Relay for 66kV CRP Panels
  - a. O/C and E/F Relay- 1 Nos
  - b. Trip Circuit Supervision relay- 2 No.
  - c. Differential Relay (with distance and line differential relay feature)- 1 No
  - d. Master trip Relay- 2 Nos
  - e. Transformer Differential Relay (with distance and line differential relay feature) - 1 No.
  - f. Transformer Monitoring Relay - 1 No.
2. Spare Relay for 11kV Panels
  - a. O/C and E/F Relay- 2 Nos
  - b. Master trip Relay- 2 Nos
  - c. Trip circuit supervision Relay– 2 Nos
  - d. REF protection relay – 1 No
3. Communication cable and Probes one of each type
4. Spare Media Converters (Optical to Digital) -1 No
5. 11 kV Board – Spares
  - a. CT and PT – 6 Nos each type
  - b. Allen Keys-2 Nos
  - c. Tool Kits-2 Nos
  - d. Discharge Rod suitable for 66kV- 2 Nos
  - e. PT Fuse HRC – 10 Nos
  - f. Vacuum Bottle for 2000A, 1250A and 800A breaker- 2 of each type
  - g. Terminal Jaws – 4 Nos
  - h. Test Terminal Block for Relays-4 Nos
  - i. Earthing Truck-1 No for each.
6. Indication lamp for CRP and HT panel each colour- 10 Nos
7. TNC Switches- 2 Nos each type
8. Voltmeter- 2 Nos each type
9. Ammeter- 2 Nos Each type
10. Push buttons for CRP and HT panels- 5 Nos for each type
11. MCB – 2 Nos for each type in loose.
12. Laptop – i7 1TB 8GB RAM of Dell/Lenovo- 1 No
13. Each Transformer NIFPS shall be provided with its cables, one extra N2 cylinder and extra valves
14. Gas filling kit 66KV SF6 C.B with all accessories-1Kit
15. SF6 GAS CYLINDERS 5Kgs-2Nos.



## **Volume-1 Technical Specification for Spares and maintenance tools and tackles**

**2.0** Maintenance tools and tackles: Following supply shall be in scope of Vendor for each package in addition to maintenance tools and tackles mentioned in individual equipment specifications, however in case of duplicacy/repetition only once shall be considered with quantity most stringent one quantity.

1. Torque Spanners---4 Nos
2. Cable Spiking tool (UV Make)---1 No
3. Three Phase Secondary Injection Kit (as per specs) of Omicron make- 1 No

Note: Approval of Model no and make wherever not defined shall be done at the time of Bid evaluation

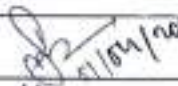

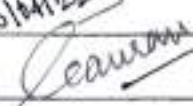


## Technical Specification

Of

### Conventional Oil filled Distribution Transformer

### Specification no – BSES-TS-12-TRDU-R0

Rev:	0	
Date:	01 Apr 2022	
Prepared by	Vani Sood / Pronab Bairagi	 01/04/2022
	Abhishek Harsh	
Reviewed by	Srinivas Gopu	 01/04/22
	Amit Tomar	
Approved by	Gaurav Sharma	 01/04/22
	K. Sheshadri	

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BSES-TS-12-TRDU-R0

TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER

**Record of Revision**

SI No.	Revision No	Item/Clause No.	Nature of change	Approved by

**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER****1.0 Scope of Supply**

For scope of supply, refer annexure – A.

**2.0 Codes & standards**

- a) Materials, equipment and methods used in the manufacture of Transformer shall conform to the latest edition of below mentioned standards.
- b) Vendor shall possess valid BIS Certification.

IS 1180	Outdoor type oil immersed distribution transformer upto and including 2.5MVA,33kV
IS 2026	Power Transformers
IS 2026-4	Terminal Marking, tappings and Connections for Power Transformers.
IS:3347	Dimensions for Porcelain Transformer bushing
IS:3637	Gas operated relays
IS:3639	Fitting & Accessories for power transformers
IS:4201	Application guide for CT's
IS:8478	Application guide for On-load tap changer
IS:10028	Code of practice for selection, installation & maintenance of transformers
IS 5561	Electrical Power Connectors
IS 5	Colors for ready mix paints
IS:335	Insulating oil
IS 6272	Industrial cooling fans
IS 12615	Three phase induction motors
IS/IEC 60034	Rotating Electrical Machines. (e.g. For Cooler Fan Motors.)
IS/IEC 60071	Co-ordination of Insulation.
IS 16227/IEC 61869	Current Transformers.
IS 8468/ IEC 60214	On Load Tap Changers
IS2026-7/IEC 60076-7	Loading Guide for Oil-Immersed Power Transformers.
IS 2026-8 /IEC 60076-8	Application Guide for Power Transformers.
IS 2026-10/IEC 60076-10	Determination of Transformer Sound Levels.

**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER**

IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code).
IS/IEC 60947	Low-Voltage Switchgear and Control gear.
IS/IEC 60137	Bushing for alternating voltage above 1000V
IS:1271/IEC 60085	Thermal evaluation and classification of electrical insulation
IEC 60076	Power transformers.
IEC 60156	Method for Determination of the Electric Strength for Insulating Oils.
IEC 60296	Specification for Unused Mineral Insulating Oils for Transformers and Switchgear.
IEC 60445	Basic & Safety principles for man-machine interface, marking and identification, Identification of Equipment Terminals and conductor terminals
BS 148	Determination of Transformer and Reactor Sound Levels.
BS 223	Application Guide for Power Transformers.
BS 2562	Terminal and Tapping Markings for Power Transformers.
	Indian Electricity Rules
	Indian Electricity Act
	CBIP manual

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows -

- i. Guaranteed Technical Particulars (GTP)
- ii. This Specification
- iii. Indian Standards / IEC standards
- iv. Approved Vendor Drawings
- iv. Other documents

**3.0 Major Design Criteria & Parameters of the Transformer**

Sr No	Description	Data by purchaser
3.1	Voltage variation on supply side	+ / - 10 %
3.2	Frequency variation on supply side	+ / - 5 %
3.3	Transient condition	- 20 % or + 10 % combined variation of voltage and frequency
3.4	Service Condition	Refer Annexure B

**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER**

3.5	Insulation level	Class A
3.6	Location of equipment	Generally Outdoor but may be located indoor also with poor ventilation
3.7	Reference design ambient temperature	50 deg C
3.8	Type	Oil immersed, core type, step down
3.9	Type of cooling	ONAN
3.10	Reference standard	IS 2026/IS 1180
3.11	No. of phases	3
3.12	No. of windings per phase	2
3.13	Rated frequency ( Hz )	50 Hz
3.14	Highest system voltage HV side	12 kV
3.15	Highest system voltage LV side	460 volt
3.16	Lightning Impulse withstand voltage , kV peak	
3.16.1	For nominal system voltage of 11 kV	75
3.17	Power Frequency Withstand Voltage kV rms	
3.17.1	For nominal system voltage of 11 kV	28
3.17.2	For nominal system voltage of 415 V	3
3.18	Clearances Phase to Phase , mm	
3.18.1	For nominal system voltage of 11 kV	180
3.18.2	For nominal system voltage of 415 V	25
3.19	Clearances Phase to Earth , mm	
3.19.1	For nominal system voltage of 11 kV	120
3.19.2	For nominal system voltage of 415 V	25
3.20	System Fault Level , HV side	350 MVA
3.21	System Fault Level , LV side	35 MVA
3.22	System earthing	
3.22.1	HV	Solidly earthed
3.22.2	LV	Solidly earthed
3.23	Ratings	250/400/630/1000/1600/2000 kVA

**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER**

3.24	Percentage Impedance at 75 deg C	
3.24.1	250/400/630 kVA	4.5 % with IS tolerance
3.24.2	1000 kVA	5.0 % with IS tolerance
3.24.3	1600/2000 kVA	6.25% with IS tolerance
3.25	Max Total losses(No Load+ Load Losses at 75°C) at 50% of the rated load , kW	
3.25.1	250 kVA	0.98
3.25.2	400 kVA	1.225
3.25.3	630 kVA	1.86
3.25.4	1000 kVA	2.79
3.25.5	1600 kVA	4.2
3.25.6	2000 kVA	5.05
3.26	Max Total losses(No Load+ Load Losses at 75°C) at 100% of the rated load , kW	
3.26.1	250 kVA	2.93
3.26.2	400 kVA	3.45
3.26.3	630 kVA	5.3
3.26.4	1000 kVA	7.7
3.26.5	1600 kVA	11.8
3.26.6	2000 kVA	15
3.27	Phase CT Ratio , Amp	
3.27.1	250 kVA	400/5
3.27.2	400 kVA	600/5
3.27.3	630 kVA	1000/5
3.27.4	1000 kVA	1500/5
3.27.5	1600 kVA	2500/5
3.27.6	2000 kVA	3000/5
3.28	HV cable size for all sizes / Conductor size	11 kV (E) grade , A2XCEWY 3C x 150 sqmm



**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER**

3.29	Busbar size on HV side for cable termination, mm x mm	50x10-Aluminium/Tinned Copper
3.30	LV cable size, 650 /1100 V grade , A2XY cable single core 630 sqmm unarmoured (approx cable dia 40 mm)/ A2XY Cable single core 1000sqmm(Approx dia. 48mm)	Cable
3.30.1	250 kVA	1 runs per phase + 1 runs in Neutral
3.30.2	400 kVA	2 runs per phase + 2 runs in Neutral
3.30.3	630 kVA	3 runs per phase + 2 runs in Neutral
3.30.4	1000 kVA	4 runs per phase + 3 runs in Neutral
3.30.5	1600 KVA	6 runs per phase + 3 runs in Neutral- single core 630 sqmm 3 runs per phase + 2 runs in Neutral- single core 1000 sqmm
3.30.6	2000 kVA	7 runs per phase + 4 runs in Neutral- single core 630 sqmm 4 runs per phase + 3 runs in Neutral- single core 1000 sqmm
3.31	Busbar size on LV side for cable termination, mm x mm	
3.31.1	250/400/630 kVA	
3.31.1.1	Phase	100 x 12-Tinned Copper/Alumium
3.31.1.2	Neutral	100 x 12-Tinned Copper/Alumium
3.31.2	1000kVA	
3.31.2.1	Phase	100 x 12-Tinned Copper 2 runs 100 x 12-Aluminium
3.31.2.2	Neutral	100 x 12-Tinned Copper 2 runs 100 x 12-Aluminium
3.31.3	1600kVA	
3.31.3.1	Phase	160 x 12-Tinned Copper 2 runs 160 x 12-Aluminium

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3.31.3.2	Neutral	160 x 12-Tinned Copper 2 runs 160 x 12-Aluminium
3.31.4	2000kVA	
3.31.4.1	Phase	2 runs 100 x 12-Tinned Copper 2 runs 160 x 12-Aluminium
3.31.4.2	Neutral	2 runs 100 x 12-Tinned Copper 2 runs 160 x 12-Aluminium
3.32	Maximum Overall Dimension Acceptable ( length x width x height), mm x mm x mm	
3.32.1	250 KVA	1500 x1300x 1700
3.32.2	400 kVA	1500X1500X2000
3.32.3	630 kVA	1700X1700X2200
3.32.4	1000 kVA	1900X1900X2500
3.32.5	1600 kVA	2300X2000X2600
3.32.6	2000 kVA	2500X2000X2600
3.33	Short Circuit withstand Capacity of the transformer	
3.33.1	Three phase dead short circuit at secondary terminal with rated voltage maintained on the other side	For 3 secs.
3.33.2	Single phase short circuit at secondary terminal with rated voltage maintained on other side	For 3 secs.
3.34	Overload Capability	As per IS 2026/IEC 60905
3.35	Noise Level	400/630/1000/1600/2000 KVA- 56/57/58/60/61 Db respectively
3.36	Radio Influence Voltage	Maximum 250 microvolt

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3.37	Harmonic suppression	Transformer to be designed for suppression of 3rd, 5th, 7th harmonic voltages and high frequency disturbances.
3.38	Partial Discharge	Transformer to be free from partial discharge upto 120 % of rated voltage as the voltage is reduced from 150 % of rated voltage i.e. there shall be no significant rise above background level
3.39	Tappings	Off Circuit taps on HV winding , +10% to - 10% in steps of 2.5 % , change of taps by externally operated switch
3.39.1	Rotary tap switch operating voltage	11 kV
3.39.2	Rotary tap switch current rating, Amp.	
3.39.2.1	250 KVA	20 Amps
3.39.2.2	400 kVA	60 Amp
3.39.2.3	630 / 1000 kVA	100 Amp
3.39.2.4	1600/2000 kVA	150 Amp

**4.0 Construction & Design**

4.1	Type	Double Copper wound, three phase, oil immersed, with ONAN cooling, with off circuit tap changer
4.2	<b>Major Parts</b>	
4.2.1	<b>Tank</b>	
4.2.1.1	Type	Non sealed type with conservator as per manufacturer's standard.
4.2.1.2	Material of Construction	Robust mild steel plate without pitting and low carbon content
4.2.1.3	Plate Thickness	Adequate for meeting the requirements of pressure and vacuum type tests as per IS
4.2.1.4	Welding features	i) All seams and joints shall be

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		<p>double welded</p> <p>ii) All welding shall be stress relieved for sheet thickness greater than 35 mm</p> <p>iii) All pipes, radiators, stiffeners, welded to the tank shall be welded externally</p>
4.2.1.5	Tank features	<p>i) Adequate space at bottom for collection of sediments</p> <p>ii) Stiffeners provided for rigidity and designed to prevent accumulation of water</p> <p>iii) No internal pockets in which gas/air can accumulate</p> <p>iv) No external pocket in which water can lodge</p> <p>v) Tank bottom with welded skid base</p> <p>vi) Tank cover sloped to prevent retention of rain water</p> <p>vii) Minimum disconnection of pipe work and accessories for cover lifting</p> <p>viii) Tanks shall be of a strength to prevent permanent deformation during lifting , jacking, transportation with oil filled.</p> <p>ix) Tank to be designed for oil filling under vacuum</p> <p>x) Tank cover fitted with lifting lug</p> <p>xi) Tank cover bent at all the ends</p> <p>xii) Minimum disconnection of pipe work and accessories for cover lifting</p>
4.2.1.6	Flanged type adequately sized	<p>i) HV line bushing</p>

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	inspection cover rectangular in shape required for	ii) LV line bushing iii) LV neutral bushing iv) Core / Winding
4.2.1.7	Fittings and accessories on main tank	See under fittings and accessories.
4.2.2	<b>Conservator for the main tank</b>	
4.2.2.1	Capacity	Adequate between highest and lowest visible levels to meet the requirement of expansion of oil volume in the transformer and cooling equipment from minimum ambient temperature to maximum operating temperatures.
4.2.2.2	Conservator oil preservation system	Conventional
4.2.2.3	Conservator features	i) Conservator shall be bolted into position so that it can be removed for cleaning / other maintenance purposes ii) Main pipe from tank shall project about 20 mm above conservator bottom for creating a sump for collection of impurities iii) Conservator minimum oil level corresponding to minimum temperature shall be well above the sump level. iv) Conservator to main tank piping shall be supported at minimum two points.

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4.2.2.4	Fittings and accessories on main tank conservator	<ul style="list-style-type: none"><li>i) Prismatic oil gauge with MINIMUM, NORMAL and MAXIMUM marking</li><li>ii) End Cover</li><li>iii) Oil Filling Hole with cap</li><li>iv) Silica Gel Dehydrating Breather with oil seal and dust filter with clear acrylic single piece clearly transparent cover resistant to UV rays(1kg). Breather shall be of Flanged type in circular shape with 4 no.holes of ½ inches with hardware of M10 bolts. Silica gel shall be of round ball type of 2.5mm dia.</li><li>v) Drain Plug</li><li>vi) Air release plug as required</li><li>vii) Pressure/ Vacuum gauge</li><li>viii) Magnetic Oil Gauge with LOW LEVEL ALARM</li></ul>
4.2.3	<b>Radiators</b>	Detachable type
4.2.3.1	Thickness	Minimum 1.2 mm
4.2.4.2	Features	With lifting lugs, air release plug,
4.2.5	<b>Core</b>	
4.2.5.1	Material	High grade , non ageing, low loss, high permeability, grain oriented, cold rolled silicon steel lamination. Core shall be low loss of 1Watt/kG (max)
4.2.5.2	Grade	Premium Grade minimum M3 or better
4.2.5.3	Lamination thickness	0.23 mm Max.
4.2.5.4	Design Flux Density at rated conditions at principal tap	As per Manufacturer design.
4.2.5.5	Maximum Flux Density at 12.5 % over	1.9 T

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	excitation / over fluxing	
4.2.5.6	Core Design Features	<p>i) Core shall be in the form of step and stack in three limb format.</p> <p>Note: Wound core shall not be acceptable</p> <p>ii) Magnetic circuit designed to avoid short circuit paths within core or to the earthed clamping structures</p> <p>iii) Magnetic circuit shall not produce flux components at right angles to the plane of lamination to avoid local heating</p> <p>iv) Least possible air gap and rigid clamping for minimum core loss and noise generation</p> <p>v) Adequately braced to withstand bolted faults on secondary terminals without mechanical damage and damage/ displacement during transportation and positioning.</p> <p>vi) Percentage harmonic potential with the maximum flux density under any condition limited to avoid capacitor overloading in the system</p> <p>vii) All steel sections used for supporting the core shall be thoroughly sand blasted after cutting , drilling, welding</p> <p>viii) Provision of lifting lugs for core coil assembly</p> <p>ix) Supporting framework designed not to obstruct complete drainage of oil from transformer</p>

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4.2.6	<b>Winding</b>	
4.2.6.1	Material	Electrolytic Copper
4.2.6.2	Maximum Current Density allowed	3 Amp per sq mm at all taps.
4.2.6.3	Winding Insulating material	Class A , non catalytic, inert to transformer oil, free from compounds liable to ooze out, shrink or collapse.
4.2.6.4	Winding Insulation	Uniform
4.2.6.5	Design features	<ul style="list-style-type: none"><li>i) Type of winding<ul style="list-style-type: none"><li>a. LV: Sprial/Helical</li><li>b. HV: Crossover/Disc</li></ul></li><li>Note: Foil winding shall not be acceptable</li><li>ii) Stacks of winding to receive adequate shrinkage treatment</li><li>iii) Connections braced to withstand shock during transport, switching, short circuit, or other transients.</li><li>iv) Minimum out of balance force in the transformer winding at all voltage ratios.</li><li>v) Conductor width on edge exceeding six times its thickness</li><li>vi) Transposed at sufficient intervals.</li><li>vii) Coil assembly shall be suitably supported between adjacent sections by insulating spacers + barriers</li><li>viii) Winding leads rigidly supported , using guide tubes if practicable</li><li>ix) Winding structure and major insulation not to obstruct free flow of oil through ducts</li><li>x) Provision of taps as per clause 3.39</li></ul>



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4.2.7	<b>Transformer Oil</b>	
4.2.7.1	Type	Should be in accordance with specification as per Annex C of this document
4.2.8	<b>Bushings and Terminations</b>	
4.2.8.1	Type of HV side bushing	HV bushing should be top mounted. Outdoor, Pcelain, rated voltage and creepage as per 31mm/kV with voltage class of 12kV respectively
4.2.8.2	Type of LV side bushing	LV bushing should be top mounted. Outdoor, Porcelain, rated voltage and creepage as per 31mm/kV with voltage class of 1.1 kV respectively Additional neutral bushing of porcelain outside on top of LT cable box with brass palm connector (as per IS 3347) shall be provided. Connection between the main neutral and additional neutral shall be provided. For extra neutral bushing, protection box shall be provided in order to prevent ingress of water.
4.2.8.2.1	Essential provision for LV side line bushing	It shall be complete with copper palm complete with tinned copper busbar of size shall be as per clause 3.31.
4.2.8.2.2	Essential provision for LV side neutral bushing	In case of neutral bushing the stem and busbar shall be integral without bolted, threaded, brazed joints. Busbar size shall be as per clause 3.31
4.2.8.3	Arcing Horns	Not required
4.2.8.4	Support insulators inside HV cable box if provided	Epoxy resin cast, rated voltage 12 kV
4.2.8.5	Termination on HV side bushing	By bimetallic terminal connectors

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		suitable for ACSR/AAAC conductor / Cable connection through cable box with disconnecting link suitable for 11kV(E) grade,A2XFY 3Cx 150sqmm
4.2.8.6	Termination of LV side bushing	By bimetallic terminal connectors suitable for LV Cable size of 650/1100VGrade, A2XY Cable single core 630sqmm (Approx dia 40mm) / A2XY Cable single core 1000sqmm (Approx dia. 48mm) for 1600/2000 KVA.
4.2.8.7	Minimum creepage distance of all bushings and support insulators.	31mm/KV
4.2.8.8	Protected creepage distance	At least 50 % of total creepage distance
4.2.8.9	Continuous Current rating	Minimum 20 % higher than the current corresponding to the minimum tap of the transformer
4.2.8.10	Rated thermal short time current	25 times the rated current for 2 sec
4.2.8.11	Atmospheric protection for clamp and fitting of iron and steel	Hot dip galvanizing as per IS 2633
4.2.8.12	Bushing terminal lugs in oil and air	Tinned copper
4.2.8.13	Sealing washers /Gasket ring	Nitrile cork rubber(RC70C)/ Expanded TEFLON(PTFE) as applicable.
4.2.9	<b>HV &amp; LV cable box</b>	Required
4.2.9.1	Material of Construction	Sheet Steel min. 2.5 mm thick
4.2.9.2	Cable entry	At bottom through detachable gland plate with cable clamps of non magnetic material
4.2.9.3	Cable size for HV	11 kV (E) grade , A2XFY 3C x 150 sqmm
4.2.9.4	Cable size for LV	LV cable size, 650 /1100 V grade, A2XY cable single core 630 sqmm

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		unarmoured (approx cable dia 40 mm) / A2XY Cable single core 1000sqmm (Approx dia. 48mm) for 1600/2000 KVA.
4.2.9.5	Cable size for LV Neutral	LV cable size, 650 /1100 V grade, A2XY cable single core 630 sqmm unarmoured (approx cable dia 40 mm) / A2XY Cable single core 1000sqmm (Approx dia. 48mm) for 1600/2000 KVA.
4.2.9.6	Detachable Gland Plate material for HV, LV, LV Neutral box	i) MS for HV cable box ii) Al for LV cable box.
4.2.9.7	Gland plate thickness for HV, LV, LV Neutral box	i) 3 mm for HV side cable box ii) 5 mm for LV cable box.
4.2.9.8	Cable gland for HV cables	Nickel plated brass double compression weatherproof cable gland
4.2.9.9	Cable lug for HV, LV, LV Neutral cables	i) Double hole Aluminium lugs for LV & Neutral side ii) Single hole Aluminum lugs for HV side
4.2.9.10	Essential parts	i) Flange type removable front cover with handles min two nos. ii) Tinned Copper Busbar of adequate size for Purchaser's cable termination with busbar supports iii) Earthing boss for the cable box iv) Earthing link for the gasketed joints at two point for each joint v) Earthing provision for cable Armour/ Screen vi) Flanged type inspection cover on top for bushing inspection and maintenance with handle vii) Drain plug viii) Rainhood on gasketed vertical joint ix) Danger / caution plate

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4.2.9.11	Terminal Clearances	700mm, Minimum
4.2.9.12	Termination height required for cable termination	1000mm, Minimum
4.2.10	<b>Current Transformers</b>	
4.2.10.1	Provision	On all three phases on LV side
4.2.10.2	Mounting	On LV side bushings on all three phases with the help of fibre glass mounting plate affixed to main tank by nut bolt arrangement
4.2.10.3	Maintenance requirements	Replacement should be possible by removing fixing nut of mounting plate after removal of LT cable without disturbing LT bushing
4.2.10.4	Accuracy Class	0.5
4.2.10.5	Burden	10VA
4.2.10.6	Type	Resin Cast Ring type suitable for outdoor use.
4.2.10.7	CT ratio	
	250 KVA	400/5
	400kVA	600/5
	630kVA	1000/5
	1000kVA	1500/5
	1600kVA	2500/5
	2000kVA	3000/5
4.2.10.8	<b>CT terminal Box</b>	
4.2.10.8.1	Size	650 mm height x 750 mm width x 275 mm depth.
4.2.10.8.2	Fixing of instrument / meters within box	On slotted channel 40 x 12 mm size, channel fixed on vertical slotted angle 40 x 40 mm size at two ends
4.2.10.8.3	No of horizontal channels to be provided	Four
4.2.10.8.4	Fixing of terminals within the box	On horizontal slotted channel with the

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		help of C channel available with the terminals
4.2.10.8.5	Location	On tank wall
4.2.10.8.6	Box door design	Openable from outside with antitheft hinge, padlock facility, door fixed by stainless steel allen screw M6 size , door shall have canopy for rain protection
4.2.10.8.7	Terminal strip	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit.
4.2.10.8.8	Cables and wires	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sq mm for signals and 4 sq mm for CT with multi strand copper conductor
4.2.10.8.9	Cable Glands	Nickel plated brass double compression weatherproof cable gland
4.2.10.8.10	Lugs on wires	Tinned copper pre insulated Pin, Ring, Fork type as applicable
4.2.10.8.11	Potential signal in CT box	i) Tapped from main LV busbar ii) Neutral Link and Fuse to be provided by bidder for PT
4.2.10.8.12	Essential provision	Wiring diagram to be fixed on the back of door along with CT spec. on Aluminum engraved plate fixed by rivet.
4.2.11	<b>Off Circuit tap Switch</b>	
4.2.11.1	Range /Step	Off circuit taps on HV winding, +10% to -10% in steps of 2.5%, change of taps by externally operated switch.
4.2.11.2	Type	Rotary type, 3 pole gang operated,

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		draw out type
4.2.11.3	Operating Voltage	11kV
4.2.11.4	Rated Current for tap Switch	i) 400 kVA - 60 Amps ii) 630/1000 kVA - 100 Amps iii) 1600/2000kVA-150 Amps
4.2.11.5	Operating Handle	External at suitable height to be operated from ground level.
4.2.11.6	Essential provision	Tap position indicator, direction changing facility, locking arrangement, and caution plate metallic fixed by rivet.
4.2.12	<b>Pressure Relief Device</b>	
4.2.12.1	Type	Pressure Relief Valve (PRV)
4.2.12.2	Auxiliary contacts	2 NO
4.2.13	<b>Winding and Oil Temperature scanner</b>	Required
4.2.13.1	PT 100 sensor	For measurement of Oil temperature LV winding temperature.
4.2.13.2	No of potential free trip contacts	2 NO
4.2.13.3	No of potential free alarm contacts	2 NO
4.2.13.4	Auxiliary Supply	240 AC, Single phase, 50Hz. Tapped from LV side busbar through a MCB located inside box.
4.2.13.5	Communication port	RS 485 port for interfacing with FRTU on Modbus protocol. Battery/Super capacitor for data transmission to SCADA in the event of Auxiliary supply fail
4.2.13.5	Fixing of instrument	On side wall of tank
4.2.14	<b>Auxiliary Relay (hand reset type)</b>	Required to identify the type of fault/indication.
4.2.14.1	Quantity	4 no's Separate auxiliary relay to be provided for PRV, MOG,WTI/OTI,

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		Buchholz relay.
4.2.14.2	Potential free contacts	2 NO
4.2.14.3	Auxiliary supply	240V AC
4.3	<b>Hardware</b>	
4.3.1	External	Hot dip galvanized bolts
4.3.2	Internal	Cadmium plated except special hardware for frame parts and core assembly as per manufacturer's design
4.4	<b>Gasket</b>	
4.4.1	For Transformer , surfaces interfacing with oil like inspection cover etc.	Nitrile cork rubber RC70C grade
4.4.2	For Cable boxes, Marshalling box, etc.	Neoprene rubber based/ cork nitrile
4.5	<b>Valves</b>	
4.5.1	Material of construction	Brass / gun metal
4.5.2	Type	Both end flanged gate valve / butterfly valve depending on application
4.5.3	Size	As per manufacturer's standard
4.5.4	Essential provision	Position indicator, locking rod, padlocking facility, valve guard, cover plate.
4.6	<b>Cable routing on Transformer</b>	Control cables for accessories on transformer tank shall be routed through perforated GI trays
4.6.1	Control cable specification	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sq mm for signals and 4 sq mm for CT with multi strand copper conductor
4.6.2	Specification of wires to be used inside marshalling box.	PVC insulated multi-strand flexible copper wires of minimum 2.5 sq mm size, 1100 V grade as per latest edition

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		of relevant IS
4.7	<b>Terminal Blocks to be used by the vendor</b>	Nylon 66 material, minimum 4 sq mm, Stud type screw driver operated type for control wiring and potential circuit.
4.7.1	Essential provision for CT terminals	Sliding link type disconnecting terminal block Stud type screwdriver operated with facility for CT terminal shorting material of housing melamine/ Nylon66
4.8	<b>Cable glands to be used by the vendor</b>	Nickel plated brass double compression weatherproof cable gland
4.9	<b>Cable lugs to be used by the vendor</b>	
4.9.1	For power cables	Long barrel medium duty Aluminium lug with knurling on inside surface.
4.9.2	For Control Cable	Tinned copper pre insulated Pin, Ring, Fork type as applicable
4.10	<b>Painting of transformer, Radiator, marshalling box for CT, cable boxes etc.</b>	
4.10.1	Surface preparation	By 7 tank pretreatment process or shot blasting method
4.10.2	Finish on internal surfaces of the transformer	Bright Yellow heat resistant and oil resistant paint two coats. Paint shall neither react nor dissolve in hot transformer insulating oil.
4.10.3	Finish on inner surface of the CT terminal box, HV/LV/LVN cable box	White Polyurethane paint anti condensation type two coats , minimum dry film thickness 80 microns
4.10.4	Finish on outer surface of the transformer, radiator, CT terminal box, HV/LV/LVN cable box	Battle ship Grey shade 632 Polyurethane paint two coats, minimum dry film thickness 80 microns
4.10.5	Frame parts	Battle ship grey shade 632 IS 5, 80 micron minimum insulating oil resistant





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		paint. Paint shall neither react nor dissolve in hot transformer insulating oil.
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**5.0 Fittings and Accessories on Transformer**

5.1	Rating and Diagram Plate	Required
5.1.1	Material	Anodized aluminum 16SWG
5.1.2	Background	SATIN SILVER
5.1.3	Letters, diagram & border	Black
5.1.4	Process	Etching
5.1.5	Rating and Diagram Plate details	Following details shall be provided on rating and diagram plate as a minimum i) type/kind of transformer with winding material ii) standard to which it is manufactured iii) manufacturer's name; iv) transformer serial number; v) month and year of manufacture vi) rated frequency in Hz vii) rated voltages in kV viii) number of phases ix) rated power in kVA x) type of cooling (ONAN) xi) rated currents in A xii) vector group connection symbol xiii) 1.2/50 $\mu$ s wave impulse voltage withstand level in kV xiv) power frequency withstand voltage in kV xv) impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap xvi) Max. Total losses at 50 % rated

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		<p>load</p> <p>xvii) Max. Total losses at 100 % rated load</p> <p>load</p> <p>xviii) Load loss at 50% &amp; 100% rated load</p> <p>load</p> <p>xix) No-load loss at rated voltage and frequency</p> <p>xx) Energy efficiency level.</p> <p>xxi) continuous ambient temperature at which ratings apply in deg C</p> <p>xxii) top oil and winding temperature rise at rated load in deg C;</p> <p>xxiii) winding connection diagram with taps and table of tapping voltage, current and power</p> <p>xxiv) transport weight of transformer</p> <p>xxv) weight of core and windings</p> <p>xxvi) Weight of core</p> <p>xxvii) Weight of winding</p> <p>xxviii)total weight</p> <p>xxix) volume of oil</p> <p>xxx) weight of oil</p> <p>xxxii) name of the purchaser</p> <p>xxxii) PO no and date</p> <p>xxxiii)Guarantee period</p>
5.2	Terminal marking Plate for Bushing, anodized aluminium black lettering on satin silver background both inside cable boxes near termination and on cable box cover (all fixed by rivet)	Required
5.3	Company Monogram Plate fixed by rivet	Required
5.4	Lifting Lug to lift complete	Required

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	transformer with oil	
5.5	Lifting lug for top cover	Required
5.6	Lashing Lug	Required
5.7	Jacking Pad with Haulage hole to raise or lower complete transformer with oil	Required
5.8	Detachable Bidirectional flat roller Assembly	Required
5.8.1	Roller center to center distance	Minimum 900 mm on the side of HV and LV cable box Maximum 800 mm on the other side (perpendicular to HV, LV cable box).
5.8.2	Essential provision	Roller dia 150 mm min., roller to be fixed in such a way so that the lowermost part of the skid is above ground by at least 100 mm when the transformer is installed on roller.
5.9	Pockets for ordinary thermometer on tank cover with metallic identification plate fixed by rivet.	Required
5.10	Drain valve (gate valve) for the main tank with cork above ground by 150mm minimum with padlocking and valve guard with metallic identification plate fixed by rivet.	Required
5.11	Filter valve (gate valve) at top with padlocking and valve guard with metallic identification plate fixed by rivet.	Required
5.12	Air Release Plug on tank cover with metallic identification plate fixed by rivet.	Required
5.13	Earthing pad on tank for	Required

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	transformer earthing complete with non ferrous nut , bolt, washers, spring washers etc. with metallic identification plate fixed by rivet	
5.14	Rainhood for vertical gasketed joints , in cable boxes, Conservator	Required Not required as per Annexure A Scope of supply
5.15	Earthing bridge by copper strip jumpers on all gasket joints at at least two points for electrical continuity	Required
5.16	Skid base welded type with haulage hole	Required
5.17	Core , Frame to tank Earthing	Required
5.18	Danger plate made of Anodized aluminum with white letters on red background on Transformer, cable boxes (all fixed by rivet)	Required
5.19	Caution plate for Off Circuit tap changer fixed by rivet.	Required
5.20	MOG with auxiliary contact wired upto Terminal Box	Required
5.21	Buchholz relay for transformer above 1000kVA	Required
5.22	Pressure relief valve	Required
5.23	WTI & OTI Temperature Scanner	Required
5.24	Auxiliary relays (4 no's)	Required
5.25	LT cable support-By aluminium clamp fixed on the on MS bracket of size 50x 10 supported from the tank wall shall be provided .	Required
5.26	HT cable support-By GI clamp fixed on the on MS bracket of size 50x 10 supported from the tank wall shall	Required

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be provided.

**6.0 Approved make of components**

6.1	CT	Pragati / ECS / Kappa/Mehru/Continental/Nortex
6.2	Bushings	Baroda Bushing/Jaipur glass/CJI
6.3	Tap Changer	Always /Paragon
6.4	MOG	Sukrut/Atvus
6.5	Valves	Newman/ATAM
6.6	CRGO	Nippon/JFE/Posco/Thyson kkurup
6.7	Copper	Birla copper/Sterlite
6.8	Pre compressed Pressboard	Raman Board, Mysore/ Senapathy Whiteley
6.9	Laminated Wood	Permalli Wallance / Rochling Engineers
6.10	Oil	Apar/Savita/Raj Petro/Gandhaar
6.11	Steel	TATA/Jindal/SAIL
6.12	Lugs/Glands	Jainson/Dowells/Comet
6.13	Radiators	CTR/Hi-Tech Radiators /Tarang Engineers
6.14	WTI/OTI	Precimeasure/ Pecon
6.15	Buchholz Relay	Sukrut/Atvus
6.16	Auxiliary Relay	GE/Alstrom

Note – Any other make of component offered by the bidder maybe reviewed & approved by purchaser

**7.0 Quality assurance**

7.1	Quality Assurance program	To be submitted before contract award. Program shall contain following i) The structure of the organization ii) The duties and responsibilities assigned to staff ensuring quality of work. iii) The bidder should have qualified technical & dedicated QA
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		<p>personnel at various stages of manufacture &amp; testing.</p> <ul style="list-style-type: none"> <li>iv) Factory inspection of bidder may be carried out to ascertain the quality system and process in place at manufacturing facility. The same is applicable to bidders not approved with BSES.</li> <li>v) The system for purchasing, taking delivery and verification of materials</li> <li>vi) The system for ensuring quality of workmanship</li> <li>vii) The system for control of documentation</li> <li>viii) The system for the retention of records</li> <li>ix) The arrangements for the Supplier's internal auditing</li> <li>x) A list of the administration and work procedures required to achieve and verify Contract's quality requirements. These procedures shall be made readily available to the Purchaser for inspection on request</li> </ul>
7.2	Quality Plan	<p>To be submitted by the successful bidder for approval. Plan shall contain following as a minimum</p> <ul style="list-style-type: none"> <li>i) An outline of the proposed work and programm sequence</li> <li>ii) The structure of the Supplier's organisation for the contract</li> <li>iii) The duties and responsibilities assigned to staff ensuring quality of work for the contract</li> <li>iv) Inspection Hold and notification points mutually agreed.</li> <li>v) Submission of engineering documents required by the specification</li> <li>vi) The inspection of materials and components on receipt</li> <li>vii) Reference to the Supplier's work</li> </ul>

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		<p>procedures appropriate to each activity</p> <p>viii) Inspection during fabrication/ construction</p> <p>ix) Final inspection and test</p> <p>x) Successful bidder shall include submittal of Mills invoice, Bill of lading, Mill's test certificate for grade, physical tests, dimension, specific watt loss per kG for the core material to the purchaser for verification in the quality plan suitably</p>
7.3	Manufacturing Quality Assurance Plan	Refer Annexure D

**8.0 Progress Reporting**

8.1	Outline Document	To be submitted for purchaser approval for outline of production, inspection, testing, packing, dispatch, documentation programme
8.2	Detailed Progress report	<p>To be submitted to Purchaser once a month containing</p> <p>i) Progress on material procurement</p> <p>ii) Progress on fabrication</p> <p>iii) Progress on assembly</p> <p>iv) Progress on internal stage inspection</p> <p>v) Reason for any delay in total programme</p> <p>vi) Details of test failures if any in manufacturing stages</p> <p>vii) Progress on final box up</p> <p>viii) Constraints</p> <p>ix) Forward path</p>

**9.0 Inspection & testing**

9.1	Inspection and Testing during manufacture	Only type tested equipment shall be acceptable
9.1.1	Tank and Conservator	i) Check correct dimensions between wheels demonstrate turning of wheels through 90 deg and further dimensional check.

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		<ul style="list-style-type: none"> <li>ii) Check for physical properties of materials for lifting lugs, jacking pads etc. All load bearing welds, including lifting lug welds shall be subjected to</li> <li>iii) required load tests.</li> <li>iv) Leakage test of the conservator.</li> <li>v) Certification of all test results.</li> <li>vi) Oil leakage test .</li> <li>vii) Vacuum and Pressure test on tank as type test as per IS</li> </ul>
9.1.2	Core	i)
9.1.2.1	Mother Core coil	Verification & inspection of the mother coil at port & putting stamp & seal may be inspected by BSES.
9.1.2.2	Core sample type testing	<p>Reconciliation of mother coil by checking stamp &amp; seal at factory before slitting. One sample of CRGO to be sealed for testing at ERDA/CPRI. Following Tests shall be conducted on the sample per P.O.</p> <ul style="list-style-type: none"> <li>i) Specific core loss measurement</li> <li>ii) Magnetic polarization</li> <li>iii) Magnetic permeability</li> <li>iv) Specific core loss measurement after accelerated ageing test</li> <li>v) Surface insulation resistivity</li> <li>vi) Electrical resistivity measurement</li> <li>vii) Stacking factor</li> <li>viii) Ductility(Bend test)</li> <li>ix) Lamination thickness</li> <li>x) Magnetization characteristics (B-H curve)</li> </ul>
9.1.2.3	Core cutting	Bidder should have in house core cutting facility for proper monitoring & control on quality. In case it is done outside cutting shall be done in presence of BSES.
9.1.2.4	Core physical verification	<ul style="list-style-type: none"> <li>i) Check on the quality of varnish if used on the stampings. <ul style="list-style-type: none"> <li>a) Measurement of thickness and hardness of varnish on stampings.</li> <li>b) Solvent resistance test to check that varnish does not react in hot oil.</li> <li>c) Check over all quality of varnish by sampling to ensure uniform hiping colour, no bare spots. No ever burnt</li> </ul> </li> </ul>



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		<p>varnish layer and no bubbles on varnished surface.</p> <ul style="list-style-type: none"> <li>ii) Check on the amount of burns.</li> <li>iii) Bow check on stampings.</li> <li>iv) Check for the overlapping of stampings. Corners of the sheet are to be apart.</li> <li>v) Visual and dimensional check during assembly stage.</li> <li>vi) Check on complete core for measurements of iron-loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.</li> <li>vii) Check for inter laminar insulation between core sectors before and after pressing.</li> <li>viii) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.</li> <li>ix) High voltage test (2 KV for one minute) between core and clamps.</li> </ul> <p>Certification of all test results.</p>
9.1.2.5	Documents verification	<p>Following documents to be submitted during the stage inspection</p> <ul style="list-style-type: none"> <li>i) Invoice of supplier</li> <li>ii) Mills test certificates</li> <li>iii) Packing list</li> <li>iv) Bill of lading</li> <li>v) Bill of entry certificates by customs</li> </ul>
9.1.3	Insulating Materials	<ul style="list-style-type: none"> <li>i) Sample check for physical properties of materials.</li> <li>ii) Check for dielectric strength.</li> <li>iii) Visual and dimensional checks.</li> <li>iv) Check for the reaction of hot oil on insulating materials.</li> <li>v) Certification of all test results.</li> </ul>
9.1.4	Windings	<ul style="list-style-type: none"> <li>i) Sample check on winding conductor for mechanical properties and electrical conductivity.</li> <li>ii) Visual and dimensional check on conductor for scratches, dept. mark etc.</li> <li>iii) Sample check on insulating paper for</li> </ul>

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		<p>PE value, Bursting strength, Electric strength.</p> <p>iv) Check for the reaction of hot oil on insulating paper.</p> <p>v) Check for the bending of the insulating paper on conductor.</p> <p>vi) Check and ensure that physical condition of all materials taken for winding is satisfactory and free of dust.</p> <p>vii) Check for absence of short circuit between parallel strands.</p> <p>viii) Check for Brazed joints wherever applicable.</p> <p>ix) Measurement of voltage ratio to be carried out when core/ yoke is</p> <p>x) completely restocked and all connections are ready.</p> <p>xi) Certification of all test results.</p>
9.1.4.1	Checks before drying process	<p>i) Check conditions of insulation on the conductor and between the windings.</p> <p>ii) Check insulation distance between high voltage connection distance between high voltage connection cables and earthed and other live parts.</p> <p>iii) Check insulation distance between low voltage connection and earthed and other parts.</p> <p>iv) Insulation test of core earthing.</p> <p>v) Check for proper cleanliness</p> <p>vi) Check tightness of coils i.e. no free movement.</p> <p>vii) Certification of all test results.</p>
9.1.4.2	Checks during drying process	<p>i) Measurement and recording of temperature and drying time during vacuum treatment.</p> <p>ii) Check for completeness of drying.</p> <p>iii) Certification of all test results.</p>
9.1.5	Oil sample testing	<p>One sample of oil drawn from every lot of transformer offered for inspection should be tested at CPRI/ERDA lab for tests as listed under Table-1 of IS:1866 (2000). The cost of this testing should be included within the</p>

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		cost of transformer.
9.1.6	Test on fittings and accessories	As per manufacturer's standard
9.2	Routine tests	<p>The sequence of routine testing shall be as follows</p> <ul style="list-style-type: none"> <li>i) Visual and dimension check for completely assembled transformer</li> <li>ii) Measurements of voltage ratio</li> <li>iii) Measurements of winding resistance at principal tap and two extreme taps.</li> <li>iv) Vector Group and polarity test</li> <li>v) Measurements of insulation resistance*</li> <li>vi) Separate sources voltage withstand test.</li> <li>vii) Measurement of iron losses and exciting current at rated frequency and 90%, 100% and 110% rated voltage.</li> <li>viii) Induced voltage withstand test.</li> <li>ix) Load losses measurement at 50 % &amp; 100 % of load.</li> <li>x) Impedance measurement of principal tap (HV and LV) of the transformer.</li> <li>xi) Routine test of tanks</li> <li>xii) Induced voltage withstand test (to be repeated if type tests are conducted).</li> <li>xiii) Measurement of Iron loss (to be repeated if type test are conducted).</li> <li>xiv) Measurement of capacitance and Tan Delta for transformer winding and Tan Delta for transformer oil (for all transformers).</li> <li>xv) Ratio of CT</li> <li>xvi) Oil leakage test on completely assembled transformer</li> <li>xvii) Magnetic balance test</li> <li>xviii) Power frequency voltage withstand test on all auxiliary circuits</li> <li>xix) Certification of all test results.</li> <li>xx) Temperature Rise Test #</li> </ul> <p>Note: a) *Insulation resistance measurement</p>

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		<p>shall be carried out at 5kV for HV and 1kV for LV. Value of IR should not be less than 1000 Mohms. Polarization Index (PI = <math>IR_{10min}/IR_{1min}</math>) should not be less than 1.5 (If one minute IR value is above 5000 Mohms and it is not be possible to obtain an accurate 10 minutes reading, in such cases polarization index can be disregarded as a measure of winding condition.)</p> <p>b) #Temperature rise test may be necessary to be carried one unit/lot. Purchaser's engineer, will at its discretion, select transformer for temp. rise test from any lot offered for inspection at manufacturer's works and witness the same for comparison with ERDA/CPRI type test results</p> <p>c) BSES may appoint recognized testing authority like CPRI /ERDA lab with their instruments &amp; engineer's team and measure no load loss, load loss and percentage impedance of the transformer at supplier's works at our own cost. Bidder shall agree and give them full co-operation during their stay &amp; testing at shop floor. The losses &amp; impedance values so obtained will be considered as final.</p>
9.3	Acceptance test at NABL lab	<p>Bidder should have in-house NABL accredited testing facility. In case of unavailability of same, one Transformer of each rating shall be randomly selected and sealed by BSES Representative for complete acceptance test as per IS 1180 ( including temperature test) at third party NABL Lab. Tests shall be conducted once per Rate contract.</p>
9.4	Type Tests	<p>On one transformer of each rating and type at CPRI/ERDA.</p> <p>i) Impulse withstand test on all three HV limbs of the transformers for chopped wave as per standard</p> <p>ii) Temperature rise test as per IS</p> <p>iii) Dissolved gas analysis before and after Temperature Rise Test</p>

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		<p>iv) Pressure and Vacuum test on tank</p> <p>v)</p> <p>Note – Purchaser may choose to carry out short circuit, impulse &amp; temperature rise test on one unit from a lot offered from inspection at CPRI/ERDA</p>
9.5	Special Tests	<p>On one transformer of each rating and type</p> <p>i) Dynamic &amp; Thermal (3 sec) Short Circuit Test as per IS 2026</p> <p>ii) Measure of zero seq. impedance (Cl. 16.10 IS 2026 Part I).</p> <p>iii) Measurement of acoustic noise level (Cl. 16.12 of IS 2026 Part I).</p> <p>iv) Measurement of harmonic level on no load current.</p> <p>v) Paint adhesion test.</p> <p>vi) High voltage withstand test shall be performed on the auxiliary equipment and wiring after complete assembly. Cost of such tests, if extra, shall be quoted separately by the Bidder.</p>
9.6	Notification to bidders	<p>In case bidder had conducted type &amp; special tests from CPRI/ERDA on BSES design and there is no design change in the transformer less than 10 years from the date of the bid opening, then bidder need not to conduct the type test from CPRI/ERDA lab.</p> <p>The bidder shall submit the under taking that there is no change in design with respect to type tested design.</p>
		<p>The product offered must be of type tested quality.</p> <p>In case the product offered is never type &amp; special tested the same (as per above clause 9.4.&amp; 9.5), is to be conducted by bidder at his own cost at CPRI/ERDA</p>
9.7	Customer Hold Point	<p>i) GTP &amp; Drawings approval</p> <p>ii) Core Inspection(See CI No 9.1.2) Sample to be tested at CPRI/ERDA for each lot.</p> <p>iii) Tank Pressure &amp; vacuum Test</p>



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iv) Core & Coil Stage inspection of each lot to be offered for final testing.

**10.0 Packing , Shipping, Handling and Storage**

10.1	Packing	
10.1.1	Packing protection	Against corrosion, dampness, heavy rains, breakage and vibration
10.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection
10.1.3	Packing details	On each packing case details required as follows i) Individual serial number; ii) Purchaser's name; iii) PO number; iv) Destination; v) Supplier's name; vi) Name and address of supplier's agent vii) Description and quantity viii) Manufacturer's name ix) Country of origin x) Case measurements xi) Gross and net weights in kilograms xii) All necessary slinging and stacking instructions.
10.2	Shipping	i) The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, overhead lines, free access etc. from the manufacturing plant to the project site; and furnish to the Purchaser confirmation that the proposed packages can be safely transported, as normal or oversize packages, upto the plant site. ii) Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser



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10.3	Handling and Storage	As per manufacturer's instruction
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**11.0 Deviations**

Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, requirements of the Specification shall be met without exception.

**12.0 Drawings& Data Submission Matrix**

Drawing submission shall be as per the matrix given below. All documents/ drawing shall be provided on A3/A4 sheet in box file with separators for each section. PDF shall also be provided of all documents via USB. Deviation sheet and GTP shall be provided in excel sheet. Language of the documents shall be English only. Deficient/ improper document/ drawing submission may liable for rejection.

S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
1	Copy of specification along with company seal & signature on each page.	✓	✓	
2	Guaranteed technical particulars	✓	✓	
3	Outline dimension drawing for each major component, general arrangement drawing showing component layout an general schematic diagrams.	✓	✓	
4	Type test certificates, where available, and sample routine test reports	✓	✓	
5	Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating	✓		
6	Details of manufacturers quality assurance standard and programme and ISO 9000 series or equivalent national certification.	✓		
7	Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.	✓		
8	Recommended spare parts and consumable items for the five years of operation with prices and spare	✓		

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S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
	parts catalogue with price list for future requirements.			
9	Transport / shipping dimension and weights, space required for handling parts for maintenance	✓		
10	Write up on oil preservation system.		✓	✓
11	Quality assurance program.	✓	✓	
12	Programme for production and testing		✓	
13	General description of the equipment and all components, including brochures		✓	
14	Detailed dimension drawing for all components ,general arrangement drawing showing detailed component layout and detailed schematic and wiring drawings for all components like marshalling box and OTI/WTI scanner, PRV, Buchhloz relay. Auxiliary relays		✓	
15	Calculations to substantiate choice of electrical, structural, mechanical component size, ratings		✓	
16	Detailed loading drawing to enable the purchaser to design and construct foundations for the transformer.		✓	
17	Transport /shipping dimension with weights ,wheel base details, untanking height etc.		✓	
18	Terminal arrangements and cable box details		✓	
19	Flow diagram of cooling system showing no. of cooling banks		✓	
20	Drawings of major components like bushing,CT, OTI/WTI Scanner, PRV, Buchholz relay, Auxiliary relays, Valves, radiators etc		✓	
21	Lists of makes of all fittings and accessories		✓	
22	Statement drawing attention to all exposed points in the equipment at which contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point		✓	



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S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
23	Detailed installation and commissioning instructions			✓
24	Inspection and test reports carried out in manufacturers works			✓
25	Test certificates of all bought out items. and catalogues			✓
26	Operation and maintenance instructions as well as trouble shooting charts.			✓

**Annexure A Scope of supply****1.0 The scope of supply shall include following**

- 1.1 Design, manufacture, assembly, testing at stages of manufacture as per Cl. 9 of this specification, final testing at manufacturer works on completely assembled transformer before dispatch, packing, transportation, delivery and submission of all documentation for the Power transformer with all accessories as below

Sr. No	Description	Scope of Supply
1.1.1	Fully assembled transformer with all major parts like conservator, Radiators, CT box, Fittings and accessories as per Clause 5.0 of this specification	YES
1.1.2	Off circuit tap changer as per this specification	YES
1.1.3	HV, LV, cable boxes	YES
1.1.4	Support steel material for support of cable boxes from ground	YES

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1.1.5	Foundation Bolts for complete transformer	YES
1.1.6	Support structure to support of cable from the transformer tank	YES
1.1.7	Nickel Plated brass double compression glands for HV and LV, LVN cables (in case of termination by cable)	YES
1.1.8	Long barrel medium duty Aluminium lugs for power cables (in case of termination by cable)	YES
1.1.9	Nickel Plated brass double compression glands and tinned copper lugs for control cable termination in CT box for vendor's cables	YES
1.1.10	Cables and wires for transformer accessories and internal wiring of CT box	YES
1.1.11	Touch up paint, minimum 2 litres	YES
1.1.12	Extra Transformer oil 10 % in non returnable drums	YES
1.1.13	One spare complete set of gaskets	YES
1.1.14	Routine testing as per Cl. 9.2 & 9.3 of this specification	YES
1.1.15	Type testing as per Cl. 9.4 of this specification	YES
1.1.16	Special testing as per Cl. 9.5 of this specification	YES
1.1.17	Submission of Documentation as detailed below	YES

**Annexure B Service Conditions**

1.0.0	Delhi Atmospheric conditions	
a)	Average grade atmosphere :	Heavily polluted, dry
	Maximum altitude above sea level	1000 M
b)	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
	Design ambient temperature	50 deg C
c)	Relative Humidity	90 % Max
d)	Seismic Zone	4
e)	Rainfall	750 mm concentrated in four months



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**TECHNICAL SPECIFICATION FOR 250/400/630/1000/1600/2000KVA, 11/0.415 KV  
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Transformer oil shall be new and conform to the following requirements:

## 1.0 Codes &amp; standards

Latest revision of following codes & standards with all amendments –

	Standard no	Title
1.1	IS 335	New insulating oils
1.2	IS 1783	Drums for oils

**2.0 Properties**

The insulating material shall have following features

Sr No	Item description	Specification requirement
<b>2.1</b>	<b>Function</b>	
2.1.1	Viscosity	
2.1.1.1	Viscosity at 40 <sup>o</sup> C	15 mm <sup>2</sup> /s, Max
2.1.1.2	Viscosity at 0 <sup>o</sup> C	1800 mm <sup>2</sup> /s, Max
2.1.2	Pour Point	- 10 <sup>o</sup> C, Max
2.1.3	Water content	30 mg/Kg, Max
2.1.4	Breakdown voltage	
2.1.4.1	New unfiltered oil	30 kV, Min
2.1.4.2	After filtration	70 kV, Min
2.1.5	Density at 20 <sup>o</sup> C	0.895 g/ml, Max
2.1.6	Dielectric dissipation factor at 90 <sup>o</sup> C	0.005, Max
2.1.7	Particle Content	Manufacturer to specify the data
<b>2.2</b>	<b>Refining/Stability</b>	
2.2.1	Appearance of oil	Clear, free from sediment and suspended matter
2.2.2	Acidity	0.01 mg KOH/g, Max
2.2.3	Interfacial tension at 27 <sup>o</sup> C	0.04 N/m, Min
2.2.4	Total sulphur content	Manufacturer to specify the data
2.2.5	Corrosive sulfur	Not-corrosive
2.2.6	Potentially Corrosive sulfur	Not-corrosive
2.2.7	DBDS	Not detectable (<5 mg/kg)
2.2.8	Inhibitor	Not detectable (<0.01%)
2.2.9	Metal Passivator	Not detectable (<5 mg/kg)
2.2.10	Other additives	Manufacturer to specify the data
2.2.11	2-furfural and related Compounds content	Not detectable (<0.05 mg/kg) for each individual compound
<b>2.3</b>	<b>Performance</b>	
2.3.1	Oxidation stability, test duration 164 h	
2.3.1.1	Total acidity	1.2 mg KOH/g, Max
2.3.1.2	Sludge	0.8%, Max
2.3.1.3	DDF at 90 <sup>o</sup> C	0.5, Max



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<b>Sr No</b>	<b>Item description</b>	<b>Specification requirement</b>
2.3.2	Gassing Tendency	Manufacturer to specify the data
2.3.3	ECT	Manufacturer to specify the data
<b>2.4</b>	<b>Health,safety and Environment</b>	
2.4.1	Flash point	135 <sup>0</sup> C, Min
2.4.2	PCA content Max	3%, Max
2.4.3	PCB content	Not detectable (<2 mg/Kg)



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Annexure D Manufacturing Quality Assurance Plan

SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
<b>A</b>	<b>RAW Material</b>										
1	<b>Winding Conductor (PICC)</b>										
1.1	Bare Dimensions & Finish of Conductor	Major	Measurement	1 sample per size per lot	IEC 13730 Part 27,IEC 60317,IS 7404,IS 6160,IS 613	IEC 13730 Part 27,IEC 60317,IS 7404,IS 6160,IS 613	Supplier's TC	P	V	R	
1.2	Increase in dimensions due to Paper covering	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.3	Resistivity @ 20°C	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.4	No of Layers	Critical	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.5	Conductor Tensile strength	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.6	Conductor Elongation	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.7	% Overlap of Paper	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.8	Corner Radius	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9	<b>Kraft Paper Insulation</b>										
1.9.1	Thickness	Major	Measurement	1 sample per size per lot	IEC:60554, IS:9335	IEC:60554, IS:9335	Supplier's TC	P	V	R	
1.9.2	Apparent Density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.3	Air Permeability	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.4	Tensile Index (Longitudinal and Transverse)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.5	Electrical Strength in Air	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.6	Ash Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.7	pH of 5% Aqueous Extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.8	Conductivity of 5% Aqueous Extract	Critical	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.9	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.10	Heat Stability	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.11	Degree of Polymerization	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.9.12	Elongation (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.13	Tear index	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>2.0</b>	<b>CRGO Laminations (Watt absorption)</b>										
2.1	Specific Core Loss	Major	Electrical	Random	IEC 60404, IS 3024, IS 649	IEC 60404, IS 3024, IS 649	Supplier's TC	P	V	R	
2.2	Surface Insulation resistance	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.3	Ageing Test	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.4	Stacking Factor	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.5	Waviness	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.6	Edge Burr	Major	Visual	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.7	Sample testing for Checking Specific Core loss, accelerated ageing test, Surface insulation resistivity, AC permeability and magnetization, stacking	Major	Electrical	100%	-DO-	-DO-	--	--	P	W	Sample will be randomly selected by BSES & will be send for testing at CPRI/ERDA





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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	factor, Ductility										lab.
3.12	Core Cutting	Major	Visual	Random	-DO-	-DO-	-DO-	P	W	W	
<b>3.0</b>	<b>Un-impregnated Laminated Wood</b>										
3.1	Thickness	Major	Visual	1 sample size / LOT	IS 3513/IEC 61061	IS 3513/IEC 61061	Supplier's TC	P	V	R	
3.2	Density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.3	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.4	Oil Absorption	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.5	Cross breaking strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.6	Compressive Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.7	Electric Strength in Oil	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.8	Shrinkage in oil	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.9	Tensile Strength,compressive strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>4.0</b>	<b>Press Boards (Pre-compressed)</b>										



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
4.1	Thickness	Major	Measurement	1 sample/Size/LO T	IEC:60641, IS:1576	IEC:60641, IS:1576	Supplier's TC	P	V	R	
4.2	Tensile Strength (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.3	Shrinkage in Air (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.4	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.5	Oil Absorption	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.6	Electrical Strength in Oil and air	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.7	pH of 5% aqueous extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.8	Conductivity of 5% aqueous extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.9	Compressibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.10	Ash Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.11	Apparent density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.12	Elongation (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>5.0</b>	<b>Tank and its</b>										



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	<b>accessories</b>										
5.1	Structural steel										
5.1.1	Thickness	Major	Measurement	Random	IS 2062/ IS:1576	IS 2062/ IS:1576	Suppliers TC	P	V	R	
5.1.2	Yield Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.3	Tensile Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.4	Elongation	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.5	Bend test	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.6	Chemical composition	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>5.2</b>	<b>Manufacturing of Tank and accessories</b>										
5.2.1	Dimension check	Major	Measurement	100%	MFR. Spec/ DRG/BSES approved document	MFR. Spec/ DRG/ BSES approved document	MFR. Fabrication report	P	W	R	
5.2.2	Joint preparation	Major	Measurement	100%	-DO-	-DO-	-DO-	P	V	R	
5.2.3	Assembly and alignment	Major	Visual and measurement	100%	MFR. Spec/ DRG	MFR. Spec/ DRG	MFR. Fabrication report	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
5.2.4	DP Test on Welds on Load bearing members eg. Jack Pads	Major	DP Test	100%	-DO-	-DO-	-DO-	P	W	R	
5.2.5	Pressure test	Major	Mechanical	On One unit	CBIP	CBIP	Test Report	--	P	W	STAGE INSPECTIO N
5.2.6	Vacuum test	Major	Mechanical	On One unit	CBIP	CBIP	Test Report	--	P	W	STAGE INSPECTIO N
5.2.7	<b>Leakage test</b>										
5.2.7.1	Main Unit	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R	
5.2.7.2	Conservator	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R	
5.2.7.3	Pipes	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R	
5.2.8	Surface preparation	Major	Visual	100%	MFR. STD	MFR. STD	MFR. Fabrication report	P	V	R	
5.2.9	Final Paint Coat (including Primer), Thickness & Shade	Major	Measurement	100%	MFR. STD	MFR. STD	Test report	P	V	R	
5.2.10	Paint Peel off test	Major	Visual	100%	MFR. STD	MFR. STD	Test report	--	P	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
<b>6.0</b>	<b>Bushing/Insulators</b>										
6.1	Make and rating	Critical	Visual	100%	IS 8603/IS 2099/App.Drg.	IS 8603/IS 2099/App.Drg.	Supplier's TC	P	V	R	
6.2	Visual inspection for surface smoothness, any damage, etc.	Critical	Visual	100%	-DO-	-DO-	-DO-	P	V	R	
6.3	Important dimension including Creepage distance	Major	Measurement	One sample /size / lot	-DO-	-DO-	-DO-	P	V	R/W	
6.4	Dry Power Frequency voltage withstabd test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
6.5	Air pressure test in water	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
6.6	Electro -Tinning	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
6.7	All routine electrical tests	Major	Electrical	-do-	-do-	-do-	-do-	P	V	R	
<b>7.0</b>	<b>Magnetic Oil Gauge</b>										
7.1	Make and dimensions	Major	Physical	100%	App.Drg./ Supplier Catalogue	App.Drg./ Supplier Catalogue	Supplier's TC	P	V	R	
7.2	Test for level (eg at 30°	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	Max)										
7.3	Switch contact test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
7.4	Leakage test	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
7.5	Switch operating and setting	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
7.6	Di-electric test at 2 KV AC between live terminal and body	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>8.</b>	<b>Buchholz relay</b>										
8.1	Make and type	Critical	Visual	100%	App.Drg./ Supplier Catalogue /IS 3637	App.Drg./ Supplier Catalogue /IS 3637	Supplier's TC	P	V	R	
8.2	Bore size	Major	Measurement	One/size	-DO-	-DO-	-DO-	P	V	R	
8.3	Porosity and element test	Major	Critical	100%	-DO-	-DO-	-DO-	P	V	R	
8.4	Gas volume and surge test	Major	Mechanical	One/Size	-DO-	-DO-	-DO-	P	V	R	
8.5	HV test at 2 KV AC & IR test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
8.6	Continuity for alarm/Trip	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>9.0</b>	<b>Radiator</b>										
9.1	Dimension, number of sections	Major	Measurement	100%	MFR. DRG	VTD DRG	Supplier's TC	P	V	R	
9.2	Leakage Test with Air	Major	Visual	100%	As per CBIP	As per CBIP	Supplier's TC	P	V	R	
9.3	Paint shade	Major	Visual & Measurement	Random	MFR. Specs /Drg	MFR. Specs /Drg	Supplier's TC	P	V	R	
9.4	Surface Preparation	Major	Measurement	100%	SA 2.5 of ISO 8503/2	SA 2.5 of ISO 8503/2	Supplier's TC	P	V	R	
<b>10</b>	<b>Off Circuit Tap Changer</b>										
10.1	Make, Rating and model	Major	Visual	100%	MFR. Spec/ IS 8468 /IEC 214-1989	MFR. Spec/ IS 8468 /IEC 214-1989	Supplier's TC	P	V	R	
10.2	Contact Resistance test	Major	Visual	100%	Supplier's STD	Supplier's STD	Supplier's TC	P	V	R	
10.3	Electrical Routine test	Major	Electrical	100%	IS 8468/ IEC 214	IS 8468/ IEC 214	Supplier's TC	P	V	R	
10.4	Mechanical test on diverter switch including	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	pressure test										
10.5	HV test for Auxiliary circuit	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
10.6	Mechanical test on Tap selector switch with motor drive	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
10.7	Pressure test for Oil Compartment	Major	Mechanical test	100%	-DO-	-DO-	-DO-	P	V	R	
11.0	Transformer Oil	Major	Testing	One Sample from each lot	Annexure D of BSES spec.	Annexure D of BSES spec.	STC	P	V	R	One sample of oil shall be drawn from <b>each lot of Transformer</b> offered for final inspection by BSES representative and same shall be tested at CPRI/ERDA





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								S	M	O	
1	2	3	4	5	6	7	8	9			10
											lab as per relevant std.
<b>12.0</b>	<b>OTI / WTI Scanner</b>										
12.1	Make and Model	Critical	Visual	100%	MFR. STD/App. Drg.	MFR. STD/App. Drg.	Suppliers TC	P	P	R	
12.2	Calibration	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	
12.3	Check for alarm & trip signal operation against set value	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	
12.4	HV test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
12.5	Switch Setting	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
<b>13.0</b>	<b>Bushing Metal parts</b>										
13.1	Dimension Checks	Major	Mechanical	100%	MFR. STD /IS 3347	MFR. STD /IS 3347	Supplier's TC	P	V	R	
13.2	Surface Finish	Major	Visual	100%	-DO-	-DO-	-DO-	P	V	R	
<b>14.0</b>	<b>Current Transformers</b>										
14.1	Dimensions, make	Major	Measurement	100%	MFR. STD /App. DRG. / IS 2705	MFR. STD /App. DRG. / IS 2705	Supplier's TC	P	P	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
14.2	Rating and terminal marking	Major	Physical	100%	MFR. APPD. DRG	MFR. APPD. DRG	Supplier's TC	P	P	R	
14.3	Measurement of ratio and phase angle error	Major	Electrical	100%	IS 2705	IS 2705	Supplier's TC	P	V	R	
14.4	High Voltage test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
14.5	Inter-Turn insulation test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
14.6	Polarity	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
14.7	Knee point voltage	Major	Electrical	-do-	-do-	-do-	-do-	P	V	R	Only for Class-PS NCT
14.8	Excitation current	Major	Electrical	-do-	-do-	-do-	-do-	P	V	R	Only for Class-PS NCT
14.9	Secondary winding resistance	Major	Electrical	-do-	-do-	-do-	-do-	P	V	R	Only for Class-PS NCT
<b>15.0</b>	<b>Valves/ Butterfly valves</b>										
15.1	Make & operation	Critical	Visual	100%	APP.drg./MFR. STD/IS 778	APP.drg./MFR . STD/IS 778	Supplier's TC	P	P	R	
15.2	Leakage test for body	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	



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1	2	3	4	5	6	7	8	9			10
15.3	Leakage test for top spindle	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
15.4	Mounting dimensions	Major	Measurement	100%	-DO-	-DO-	-DO-	P	P	R	
15.5	Material of Body & Seat	Major	Chemical & measurement	1 sample per lot	-DO-	-DO-	-DO-	P	V	R	
<b>16.0</b>	<b>Pressure relief Valve/Device</b>										
16.1	Make	Critical	Visual	100%	MFR. STD/ App. Drg.	MFR. STD/ App. Drg.	-DO-	P	P	R	
16.2	Operating pressure	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
16.3	Switch Contact test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	
16.4	Mounting dimensions	Major	Measurement	100%	-DO-	-DO-	-DO-	P	V	R	
16.5	HV test between body & terminal	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>17.0</b>	<b>Gasket</b>										
17.1	Appearance & Finish	Major	Mechanical	1 sample per size per lot	IS 4253-II, 1980/IS 3400	IS 4253-II, 1980/IS 3400	Supplier's TC	P	V	R	
17.2	Hardness, IRHD	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
17.3	Tensile Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
17.4	Compressibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
17.5	Compression set	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
17.6	Flexibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>18.0</b>	<b>Silica gel Breather with oil seal</b>										
18.1	Type / model/weight	Major	Visual	100%	MFR. STD /DRG	MFR. STD /DRG	Supplier's TC	P	V	R	
18.2	Color of Gel	Major	Visual	100%	-DO-	-DO-	-DO-	P	V	R	
19	<b>Control cubicle/CT terminal Box</b>										
19.1	Dimensions	Major	Measure ment	100%	BSES Approved document	BSES Approved document	Supplier's TC	P	V	R	
19.2	Hi-voltage test at 2kV RMS for one minute	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
19.3	Insulation resistance at 5000 V DC	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
19.4	Verification of component & Fittings	Major	Visual	-DO-	-DO-	-DO-	-DO-	P	V	R	



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CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER

SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
19.5	Wiring check	Major	Visual	-DO-	-DO-	-DO-	-DO-	P	V	R	
19.6	Welding, grinding, chipping	Major	Visual	--DO-	-DO-	-DO-	-DO-	P	V	R	
19.7	Paint	Major	Visual	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>B</b>	<b>In Process</b>										
<b>1</b>	<b>Winding(LV and HV)</b>										
1.1	Check for Visual, physical and dimensional Parameters and no. of parallel conductors.										
1.1.1	Measurement of axial height, OD & ID& current density calculation.	Major	Measurement	100%	MFR. Data/Drg/BSES approved document	MFR. Data/Drg/BSE S approved document	QC report/Test report	--	P	W	
1.1.2	Copper Conductor size (Bare & covered)	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
1.1.3	No. of Turns / Disc	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
1.2	Winding height	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.3	Visual inspection of Brazed joints as applicable	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
1.4	Tap Leads termination in case of tap winding	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
1.5	Current density calculation	--	--	--	--	--	--	--	P	W	
<b>1.6</b>	<b>Weight</b>	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	W	
<b>2.0</b>	<b>Core Assembly</b>										
2.1	Visual & Key Dimensional check										
2.1.1	Diagonal distance	Major	Measurement	100%	MFR.Drg/BSES approved document	MFR.Drg/BSE S approved document	QC report/Test report	--	P	W	
2.1.2	Window centre distance	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.1.3	Window height	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.2	Stack Thickness	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.3	High Voltage test at 2 KV AC for 1 min between core & core clamp, Yoke	Major	Electrical	100%	-DO-	-DO-	-DO-	--	P	W	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	bolt										
2.4	Pre-Core loss measurement	Major	Electrical	100%	-DO-	-DO-	-DO-	--	P	W	
2.5	Weight	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	W	
<b>3.0</b>	<b>Core-Coil Assembly</b>										
3.1	Top & Bottom insulation arrangement	Major	Visual	100%	MFR.Data /DRG/BSES approved document	MFR.Data /DRG/BSES approved document	QC report	--	P	R	
3.2	Lead arrangement	Critical	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
3.3	Tap & Lead End Brazing & Insulation	Critical	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
3.4	Dimension of Coil After Shrinkage	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
3.5	Verification of Major electrical clearances	Major	Visual & Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
3.6	HV/LV Connection	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
3.7	Cleanliness	Major	Visual	100%	-DO-	-DO-	-DO-	-	P	R	
<b>4.0</b>	<b>Core-Coil Assembly</b>										



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
	<b>Before Ovening</b>										
4.1	Initial Ratio test	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
<b>5.0</b>	<b>Core-coil assembly during drying</b>										
<b>5.1</b>	Measurement & recording of temperature & drying time during vacuum treatment.	Major	Visual	100%	MFR.Data /DRG	MFR.Data /DRG	QC report	--	P	R	
<b>5.2</b>	Check for completeness of drying	Major	Visual	100%	MFR.Data /DRG	MFR.Data /DRG	QC report	--	P	R	
<b>5.3</b>	Certification of all test	Major	Visual	100%	MFR.Data /DRG	MFR.Data /DRG	QC report	--	P	R	
<b>6.0</b>	<b>Core-Coil Assembly After Ovening</b>										
6.1	Ratio Test,Vector Group & Magnetic Balance test	Major	Electrical	100%	-DO-	-DO-	QC report /Test report	--	P	W	
6.2	Recording of time/Temp, Vacuum	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
6.3	Record of Moisture extract	Major	Measurement	100%	MFR. STD	MFR. STD	QC report	--	P	R	





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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
6.4	Verification of completeness & Drying	Major	Verify	100%	MFR. STD	MFR. STD	QC report	--	P	R	
6.5	Insulation resistance measurement by Megger	Major	Electrical	100%	MFR. STD	MFR. STD	Test report	--	P	R	
6.6	Earthing connection	Major	Visual	-DO-	MFR. STD	MFR. STD	QC Report	--	P	R	
<b>7.0</b>	<b>Tanking</b>										
7.1	Electrical clearance arrangement	Major	Measurement	100%	MFR. DRG	MFR. DRG	QC report	--	P	R	
7.2	Verification of Core-Frame Clamping arrangement	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
7.3	Core to frame insulation resistance test & HV test at 2 KV for min	Major	Electrical	100%	-DO-	-DO-	-DO-	--	P	R	
<b>8.0</b>	<b>Final Assembly for testing</b>										
8.1	Fittings of external accessories	Major	Visual	100%	MFR. STD /DRG	MFR. STD /DRG	Job Card	--	P	R	
8.2	Internal Oil leakage test on main unit	Major	Visual	100%	CBIP	CBIP	QC report	--	P	R	



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
8.3	Oil filtration & pressure test	Major	Visual	-DO-	IS 1180	IS 1180	-DO-	-	P	R	
<b>C</b>	<b>Final testing</b>										
<b>1</b>	<b>Routine Test</b>										
1.1	Voltage Ratio test and check of phase displacement	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test Report	--	P	W	
1.2	Winding Resistance at all tap corrected to 75°C	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.3	No Load Loss & Current @90%,100%&112.5% of rated voltage	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	To be repeated after type test.
1.4	Impedance Voltage/Short Circuit Impedance(Principal Tap)	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.5	Load Loss measurement at 50% and 100% of load @Principal, Max, MinTap	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.6	Induced over voltage	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	To be repeated after type test
1.7	Separate Source Voltage Test	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.8	Insulation Resistance &PI(10 min / 1 min)	Major	Electrical	100%	--	--	Test report	--	P	W	IR shall be more than 2000 MΩ PI Shall be more than1.5
1.9	Voltage Vector Relationship & Polarity	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.10	Magnetic Balance Test	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.11	Oil leakage test on transformer with complete fitting and accessories	Major	Visual	100%	CBIP	CBIP	Test report	--	P	W	
1.12	Polarity check & Ratio Test of LVWTI CT/	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
	Metering CT										
1.13	BDV test on Transformer Oil	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.14	Power frequency withstand on auxiliary circuit	Major	Electrical	100%	IS 2026/IS 1180	IS 2026/IS 1180	Test report	--	P	W	
1.15	Heat Run Test (Temp. Rise Test)	Major	Testing	One Unit (each lot)	IS 2026/IS 1180	IS 2026/IS 1180	Test Report	--	P	W	
1.16	Pressure relief device test	Major	Testing	One Unit (each lot)	MFR. STD	MFR. STD	Test Report	--	P	W	
1.17	Visual and dimensional check	Major	Visual	100%	Approved drawings	Approved drawings	Test Report	--	P	W	
1.18	Measurement of Cap & tandelta of Wdg, Oil and HV bushing	Major	Electrical	One unit	--	--	Test report	--	P	W	
1.19											
<b>2.0</b>	<b>Type test (One unit of each type and rating of Transformer at CPRI/ERDA)</b>										
2.1	Heat Run Test (Temp. Rise Test)	Major	Testing	One Unit	IS 2026	IS 2026	Test Report	<b>CPRI/ERDA</b>			



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
2.2	Dynamic & Thermal (3 sec) Short Circuit Test	Major	Testing	One Unit	IS 2026	IS 2026	Test Report	CPRI/ERDA			
2.3	Impulse withstand Test on all HV & LV Limb for Chopped wave.	Major	Testing	One Unit	IS 2026	IS 2026	Test Report	CPRI/ERDA			
2.4	DGA Test Before & After temperature rise	Major	Testing	One Unit	Relevant std.	Relevant std.	Test Report	CPRI/ERDA			Test shall be conducted once per PO
<b>3.0</b>	<b>Special Test (One unit of each type and rating of Transformer)</b>										
3.1	Zero Phase Sequence Test	Major	Testing	One Unit	IS 2026	IS 2026	Test Report	--	P	W	
3.2	Noise Level Test	Major	Testing	One Unit	NEMA TR-1	NEMA TR-1	Test Report	--	P	W	
3.3	No Load Harmonic Test	Major	Testing	One Unit	IS 2026	IS 2026	Test Report	--	P	W	
3.4	HV Test on all auxiliary equipment and wiring after complete assembly	Major	Testing	One Unit	--	--	Test Report	--	P	W	
<b>D</b>	<b>Dispatch &amp; Packing</b>										
1.1	Identification & packing	Major	Visual	100%	As per packing list	As per packing list	Packing List	--	P	--	



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SL NO	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANC E NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.2	Check for proper Packing	Major	Visual	100%	As per packing list	As per packing list	Packing List	--	P	--	
1.3	Visual check before dispatch	Major	Visual	100%	As per packing list	As per packing list	Packing List	--	P	--	

**Note:**

- Transformer from each lot may be opened for core and winding verification. BSES approval is be taken prior to opening the transformer.
- Type Test shall be valid for 10 years.

All IS and IEC standards with their latest revisions/amendments shall be applicable

**LEGEND:**

S: Supplier  
M: Main Contractor (Manufacturer)  
O: Owner (BSES)

P - Perform  
V - Verify  
R – Review  
W- Witness



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**TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
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**Schedule A Guaranteed Technical Particulars (Data by Seller)**

Sr.	Particulars	Specified / Required	Offered
1.0	General		
1.1	Make		
1.2	Type	Oil immersed, core type, step down located generally outdoor but may be located indoor also with poor ventilation. Bidder shall confirm full rating available in indoor location also	
2.0	Nominal Continuous Rating, KVA		
2.1	HV winding	250/400/630/1000/1600/2000kVA	
2.2	LV winding	250/400/630/1000/1600/2000kVA	
3.0	Rated voltage ( kV )		
3.1	HV Winding	11 kV	
3.2	LV Winding	415 volt	
4.0	Rated current ( Amps )	250/400/630/1000/1600/2000kVA	
4.1	HV Winding		
4.2	LV Winding		
5.0	Connections		
5.1	HV Winding	Delta	
5.2	LV Winding	Star with neutral	
5.3	Vector Group reference	Dyn11	
6.0	Impedance at principal tap rated current and frequency, ohm @75 deg C		
6.1	Impedance	4.5%/4.5% / 4.5%/ 5.0/6.25/6.25 % with IS tolerance	
6.2	Reactance		
6.3	Resistance		
6.4	X/R ratio		
6.5	Impedance at lowest tap at rated		

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	current and frequency		
6.6	Impedance at highest tap at rated current and frequency		
7.0	Resistance of the winding at 75 <sup>0</sup> C in ohm		
7.1	a) HV		
7.2	b) LV		
8.0	Zero sequence impedance in ohm		
8.1	a) HV		
8.2	b) LV		
9.0	Guaranteed maximum Total losses at principal tap at 75°C, kW		
9.1	50 % of Load	as per Spec CI 3.25	
9.2	100% of Load	as per Spec CI 3.26	
9.3	No Load Loss (Max)		
9.4	Total I <sup>2</sup> R losses of windings @ 75 deg C, KW		
9.5	Total stray loses @ 75 deg C, KW		
9.6	Total Load losses (Max.), KW		
9.7	No load loss at maximum permissible voltage and frequency (approx.),kW		
10.0	Temperature rise over reference ambient of 40 <sup>0</sup> C		
10.1	Top oil by thermometer <sup>0</sup> C	40 <sup>0</sup> C	
10.2	Winding by resistance <sup>0</sup> C	45 <sup>0</sup> C	
11.0	Efficiency		
11.1	Efficiency at 75 <sup>0</sup> C and unity power factor %		
11.1.1	at 110% load		
11.1.2	at 100% load		
11.1.3	at 80% load	Not Less than 99.5%	
11.1.4	at 60% load		
11.1.5	at 40% load		



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11.1.6	at 20% load		
11.2	Efficiency at 75 <sup>0</sup> C and 0.8 power factor lag %		
11.2.1	at 110% load		
11.2.2	at 100% load		
11.2.3	at 80% load		
11.2.4	at 60% load		
11.2.5	at 40% load		
11.2.6	at 20% load		
11.3	Maximum efficiency at 75 <sup>0</sup> C %		
11.4	Load and power factor at which it occurs		
12.0	Regulation , (%)		
12.1	Regulation at full load at 75 <sup>0</sup> C		
12.1.1	at unity power factor		
12.1.2	at 0.8 power factor lagging		
12.2	Regulation at 110% load at 75 <sup>0</sup> C		
12.2.1	at unity power factor		
12.2.2	at 0.8 power factor lagging		
13.0	Tappings		
13.1	Type		
13.2	Capacity		
13.3	Range-steps x % variation		
13.4	Taps provided on HV winding (Yes / No)		
13.5	Rated current of rotary switch		
14.0	Cooling system		
14.1	Type of cooling	ONAN	
14.2	No. of cooling unit Groups		
14.3	Capacity of cooling units		
14.4	Mounting of radiators		
14.5	Number of Radiators		
14.8	Total radiating surface , sqmm		
14.9	Thickness of radiator tubes, mm	Minimum 1.2 mm	

**TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
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15.0	Details of Tank		
15.1	Material	Robust mild steel plate without pitting and low carbon content	
15.2	Thickness of sides mm		
15.3	Thickness of bottom mm		
15.4	Thickness of cover mm		
15.5	Confirmation of Tank designed and tested for Vacuum, Pressure ( Ref: CBIP Manual ) , (Yes/ No)		
15.5.1	Vacuum mm of Hg. / (kN/m <sup>2</sup> )	As per IS	
15.5.2	Pressure mm of Hg.		
15.6	Is the tank lid sloped?	Yes	
15.7	Inspection cover provided (Yes / No)	as per spec	
15.8	Location of inspection cover (Yes / No)		
15.9	Min. dimensions of inspection cover ( provide list of all inspection cover with dimension), mm x mm		
16.0	Core		
16.1	Type:	Core	
16.2	Core material grade	Premium grade minimum M3 or better	
16.3	Core lamination thickness in mm		
16.4	Insulation of lamination	With insulation coating on both sides	
16.5	Design flux density at rated condition at principal tap, Tesla		
16.6	Maximum flux density at 12.5 % overexcitation /overfluxing, Tesla	1.9 Tesla Max allowed	
16.7	Equivalent cross section area mm <sup>2</sup>		

**TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
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16.8	Guaranteed No Load current at 100% rated voltage , Amps		
16.8.1	HV		
16.8.2	LV		
16.9	Guaranteed No Load current At 110% rated voltage, Amps		
16.9.1	HV		
16.9.2	LV		
17.0	Type of Winding		
17.1	HV		
17.2	LV		
17.3	Conductor material	Electrolytic Copper	
17.4	Current density (HV/LV)	Maximum allowed 3.0 A per sq mm at all taps	
17.5	Gauge/area of cross section of conductor		
17.5.1	a) HV		
17.5.1	b) LV		
17.6	Insulating material		
17.6.1	HV Turn		
17.6.2	LV Turn		
17.6.3	LV Core		
17.6.4	HV - LV		
17.7	Insulating material thickness, mm		
17.7.1	HV Turn		
17.7.2	LV Turn	-	
17.7.3	LV to Core		
17.7.4	HV to LV		
18.0	Minimum design clearance, mm		
18.1	HV to earth in Air		
18.2	HV to earth in oil		
18.3	LV to earth in Air		
18.4	LV to earth in oil		
18.5	Between HV & LV in Air		

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18.6	Between HV & LV in oil		
18.7	Top winding and yoke		
18.8	Bottom winding and yoke		
19.0	<b>Insulating oil</b>		
19.1	Quantity of oil           Ltrs		
19.1.1	In the Transformer tank		
19.1.2	In each radiator		
19.1.4	Total quantity		
19.2	10% excess oil furnished?	Yes in separate non returnable drums with each transformer	
19.3	Type of Oil	As per cl 4.2.7	
20.0	<b>Bushing / Support Insulator</b>		
20.1	Make	-	
20.2	Type		
20.2.1	HV side	As per Cl. 4.2.8.1 of the spec	
20.2.2	LV side	As per Cl. 4.2.8.2 of the spec	
20.3	Reference Standard		
20.4	Voltage class, kV		
20.4.1	HV side Bushing/ Support Insulator	12 kV	
20.4.2	LV side line and neutral bushing/ Support Insulator	1.1 kV	
20.5	Creepage factor for all bushing / Support Insulator mm/KV	31 mm / kV	
20.6	Rated thermal short time current		
20.6.1	HV bushing	25 times rated current for 2 secs.	
20.6.2	LV line and neutral bushing	25 times rated current for 2 secs.	
20.7	Weight, Kg		
20.7.1	HV bushing		
20.7.2	LV line and neutral bushing		
20.8	Free space required for bushing removal, mm		
20.8.1	HV bushing		
20.8.2	LV line and neutral bushing		

**TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
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21.0	<b>Terminal connections</b>		
21.1	HV	Cable size as per CI no 3.28	
21.2	LV	Cable size as per CI no 3.30	
21.3	LV Neutral	Cable size as per CI no 3.30	
22.0	<b>HV cable box</b>	Required	
22.1	Suitable for cable type,size	Cable size as per CI no 3.28	
22.2	Termination height	750 mm min.	
22.3	Gland plate dimension, mm x mm		
22.4	Gland plate Material	MS	
22.5	Gland plate thickness	3 mm min.	
22.6	Phase to phase clearance inside box,mm	180 mm	
22.7	Phase to earth inside box,mm	120 mm	
23.0	<b>LV Cable box</b>	Required	
23.1	Suitable for cable type , size	Cable size as per CI no 3.30	
23.2	Termination height	1000 mm, min.	
23.3	Gland plate dimension, mmxmm		
23.4	Gland plate material	Aluminium	
23.5	Gland plate thickness	5 mm min.	
23.6	Phase to phase	25 mm	
23.7	Phase to earth	25 mm	
24.0	L.V neutral Cable termination arrangement	Separate cable box not required (LV-N to be provided in LV cable box.)	
25.0	Current Transformer on LV phases		
25.1	Type		
25.2	Make		
25.3	Reference Standard		
25.4	CT Ratio		
25.5	Burden, VA		
25.6	Class of Accuracy		
25.7	CT terminal box size		

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26.0	Pressure release device		
26.1	Minimum pressure the device is set to rupture		
26.1.1	For Main Tank		
26.1.2	Alarm and trip contact ratings of protective devices		
27.0	Fittings Accessories Each Transformer furnished as per Clause No 5. (Bidder shall attach separate sheet giving details, make and bill of materials)		
27.1	OTI/WTI Scanner		
27.1.1	Make		
27.1.2	Model no		
27.1.3	Auxiliary supply		
27.1.4	Manual submitted (Yes/No)		
27.2	Buchholz Relay		
27.2.1	Make		
27.2.2	Model no		
27.2.3	Auxiliary supply		
27.2.4	Manual submitted (Yes/No)		
27.3	Auxiliary relays for Fault/indication identification (PRV, Buchholz relay, MOG)		
27.3.1	Make		
27.3.2	Model no		
27.3.3	Auxiliary supply		
27.3.4	Potential free contacts		
27.3.5	Manual submitted (Yes/No)		
28.0	Painting: as per clause for the transformer, cable boxes, radiator, Marshalling box (Yes/No)		
29.0	Max over all transformer dimensions	<b>As per Clause 3.32</b>	

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29.1	Length, mm		
29.2	Breadth, mm		
29.3	Height, mm		
30.0	Transformer Tank Dimensions		
30.1	Length, mm		
30.2	Breadth, mm		
30.3	Height, mm		
31.0	Weight data		
31.1	Core, kG		
31.2	Frame parts, kG		
31.3	Core and frame, kG		
31.4	Total Winding, kG		
31.5	Core , Frame, Winding, kG		
31.6	Tank, kG		
31.7	Tank lid, kG		
31.8	Empty conservator tank, kG		
31.9	Each radiator empty, kG		
31.10	Total weight of all radiators empty, kG		
31.11	Weight of oil in Tank, kG		
31.12	Weight of oil in Conservator, kG		
41.13	Weight of oil in each Radiators, kG		
31.14	Total weight of oil in Radiators, kG		
31.16	Total Transport weight of the transformer, kG		
32.0	Volume Data		
32.1	Volume of oil in main tank, litres		
32.2	Volume of oil between highest and lowest levels of main conservator, litres		
32.4	Volume of oil in each radiator, litres		
32.5	Total volume of oil in radiators,		



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	litres		
32.7	Transformer total oil volume, litres		
33.0	Shipping Data		
33.1	Weight of heaviest package, kG		
33.2	Dimensions of the largest package (L x B x H) mm		
34.3	Tests		
34.1	All in process tests confirmed as per Cl. (Yes/ No)		
34.2	All Type Tests confirmed as per Cl. (Yes / No)		
34.3	All Routine Tests confirmed as per Cl. (Yes/ No)		
34.4	All Special Tests confirmed as per Cl. (Yes/ No)		

**Schedule B Guaranteed Technical Particulars of Transformer Oil**

Bidder to submit hard copy duly filled & signed along with techno commercial offer.



**TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
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Bidder to submit separate GTP for each type of insulating oil –

Sr No	Item description	Specification requirement	Data by Vendor
1.0	Manufacturer Name		
1.1		Address	
1.2		Contact person	
1.3		Contact telephone no	
<b>2.0</b>	<b>Function</b>		
2.1	Viscosity		
2.1.1	Viscosity at 40 <sup>0</sup> C	15 mm <sup>2</sup> /s, Max	
2.1.2	Viscosity at 0 <sup>0</sup> C	1800 mm <sup>2</sup> /s, Max	
2.2	Pour Point	- 10 <sup>0</sup> C, Max	
2.3	Water content	30 mg/Kg, Max	
2.4	Breakdown voltage		
2.4.1	New unfiltered oil	30 kV, Min	
2.4.2	After filtration	70 kV, Min	
2.5	Density at 20 <sup>0</sup> C	0.895 g/ml, Max	
2.6	Dielectric dissipation factor at 90 <sup>0</sup> C	0.005, Max	
2.7	Particle Content	Manufacturer to specify the data	
<b>3.0</b>	<b>Refining/Stability</b>		
3.1	Appearance of oil	Clear, free from sediment and suspended matter	
3.2	Acidity	0.01 mg KOH/g, Max	
3.3	Interfacial tension at 27 <sup>0</sup> C	0.04 N/m, Min	
3.4	Total sulphur content	Manufacturer to specify the data	
3.5	Corrosive sulfur	Not-corrosive	
3.6	Potentially Corrosive sulfur	Not-corrosive	
3.7	DBDS	Not detectable (<5 mg/kg)	
3.8	Inhibitor	Not detectable (<0.01%)	
3.9	Metal Passivator	Not detectable (<5 mg/kg)	
3.10	Other additives	Manufacturer to specify the data	
3.11	2-furfural and related Compounds content	Not detectable (<0.05 mg/kg) for each individual compound	
<b>4.0</b>	<b>Performance</b>		
4.1	Oxidation stability, test duration 164 h		
4.1.1	Total acidity	1.2 mg KOH/g, Max	
4.1.2	Sludge	0.8%, Max	
4.1.3	DDF at 90 <sup>0</sup> C	0.5, Max	
4.2	Gassing Tendency	Manufacturer to specify the data	
4.3	ECT	Manufacturer to specify the data	
<b>5.0</b>	<b>Health,safety and Environment</b>		



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<b>Sr No</b>	<b>Item description</b>	<b>Specification requirement</b>	<b>Data by Vendor</b>
5.1	Flash point	135 <sup>0</sup> C, Min	
5.2	PCA content Max	3%, Max	
5.3	PCB content	Not detectable (<2 mg/Kg)	



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TECHNICAL SPECIFICATION FOR 400/630/1000/1600/2000KVA,11/0.415 KV  
CONVENTIONAL OIL FILLED DISTRIBUTION TRANSFORMER

Schedule C Recommended Spares (Data by Seller)

List of recommended spares as following –

Sr No	Description of spare part	Unit	Quantity
1		No	
2		No	
3		No	
4		No	
5		No	
6		No	

**NEW GRID**

**TECHNICAL SPECIFICATION**

**FOR**

**SCADA INTERFACE WORK & AUTOMATION**

<b>Prepared by</b>	<b>K A SENTIL KUMARAN</b>		<b>Rev: 1</b>
<b>Reviewed &amp; Approved by</b>	<b>BHUWANESH DWIVEDI</b>		<b>Date: 29-07-22</b>

## Chapter 6b. Technical Specification for SCADA interface work & Automation

### 1.0 INTENT OF SPECIFICATION:

This specification is intended to cover the supply and execute work related to interface of all electrical equipments with RTU panel complete with all materials and accessories for efficient and trouble free operation. In the event of any discrepancy with the listed documents, the stipulation of this specification shall govern.

### 2.0 SCOPE OF WORK

For substation, it is proposed to lay and terminate panel wirings / control cables if any between the equipments such as CT, PT, Circuit Breaker, Isolators, 11 KV Switchgear, 66,33,11 KV Control & Relay Panels, Power Transformer & its sensors – OTI, WTI, TPI, AVR, etc, REGDA relay, Capacitor Bank, NIFPS, Smoke Detectors and Battery Charger.

The scope of work under this category would include:

- Supply of SCADA materials – BCPUs & RTU with Processors (Basic License - IEC 870-5, 101, 103, 104, Modbus, IEC 61850-8-1, IEC-104 Master, IEC 104 Slave + PLC License) along with IO Modules. Other accessories such as Communication Rack, Power Supply Modules, MFM, GPS, Converters for DC to DC & Other FO Converters, Cables - FO, CAT-6, RS485, Control Cables, Connectors if any shall be in SCADA vendor's scope of supply.
- Installation, Testing & Commissioning of SCADA equipments with Control Center via IEC-104 Protocol.
- Integration, Database development & Testing of SCADA Front end equipments (Sub Station level equipments integration over Modbus TCP IP, Serial/IEC-103/IEC-61850 Protocols.
- Extraction of ICD/SCD files from IED and further integration with RTU over IEC-61850/IEC103 Protocols at site with Supplied Hardware.
- Supply of Necessary RTU Till Tool with Licenses & Softwares if any (Ex: IET600) required for ICD/SCD file configuration in RTU.
- Laying and Termination of armored Communication cables (Ethernet, Fiber Optic Patch Cards/Cable, RS 485 cables) between grid devices (Numerical Relays/BCPU, Transformer Monitoring Modules, Smoke detector, NIFPS panel, MFM, Battery Charger) to RTU/DCU/Gateway with proper tagging, and dressing upto RTU panel. Supply of Suitable Glands, White Sleeve PVC ferrule, tagging, lugs shall be scope of vendor's supply.
- Laying and termination of control cables between grid equipments (control and relay panel, NIFPS, Battery Units) to RTU for hardwired signals.
- Installation of cable trays with accessories or trench as required for the cabling work.
- Integration of PQA over Modbus TCP IP/IEC-61850 with dedicated network.
- Integration Li-Ion Battery Charger Over Modbus TCP IP/Serial with RTU.

## Chapter 6b. Technical Specification for SCADA interface work & Automation

- Preparation of cable schedule, Wiring diagrams, Training documents with Step by Step Procedures and Interconnection as built drawings.
- Separate earthing bus bars to be provided for RTU panel and it will be directly connected to grid earthing. Earth BAR material should be Copper.
- Separate earth pit with connections for Electronic cards, gateway, Switches, DCU., etc.. earthing.
- All internal wiring between BCU and C&R Panel terminals, All Numerical relays, MFM (Multifunctional meters) and other grid equipment integration should be under SCADA vendor's scope.
- Hardware & software integration of RTU, Bay Control Units along with other equipments viz. Battery Chargers, Multi Function Meters, Fire Fighting System Signals, Transformer relays (for OTI, WTI, TPI, AVR, etc.), Smoke Detector Panels, Numerical Relays, 11&33&66KV Control and Relay panel signals etc. shall be in Vendor's scope.
- FAT and Training arrangements at factory/Work shop for BSES SCADA team (6 Persons for 5 days) – Travel, Boarding, accommodation and local conveyance etc.. shall be under SCADA Vendor's Scope.

### 2.1 Cables

The following types of cables / wirings will be required for extending signals and commands. Tagging is mandatory for all types of cables. Heat shrinking ferrule sleeves with printed ferrules to be used for identifying cables & Signals.

- 2.5 mm<sup>2</sup>, multi-stranded flexible copper wire, FRLS 1.1KV HRPVC for AC & DC Supply & 1.5 mm<sup>2</sup> multi strand cables for other internal wiring for RTU.
- Red(P) and Black(N) color cable core to be used for AC and DC wiring.
- Fiber Optic Cables (GLASS&PLASTIC Types) with suitable connectors & Ethernet cables (CAT6) with conduit pipe for internal connections and GI Armored Cables for external connections.
- 2 C X 2.5 MM<sup>2</sup> multi stranded copper cable, ARM FRLS 1.1KV HRPVC for external AC / DC Power Supply.
- 10C/16/6 C x 1.5 mm<sup>2</sup>, multi stranded copper cable, ARM FRLS 1.1KV HRPVC, Application: digital signal feed back(DI/DO).
- 6 C x 1.5 mm<sup>2</sup>, multi stranded screened copper cable, ARM FRLS 1.1KV HRPVC, Application: digital signal feed back(AI).
- 3P X 1.5 mm<sup>2</sup> for DO (Digital output)
- Suitable Insulated lugs – Ring, U Type to be used for SCADA terminations.
- 2P X 0.5 mm<sup>2</sup> Screened GI Armored RS485, Twisted pair(2 Pair), 22gauge Belden 8761 or equivalent for external (RTU to BCUs /MFM/BATT.CHG/Transformer Monitoring Devices) RS 485 connections.

## Chapter 6b. Technical Specification for SCADA interface work & Automation

The supplied cable shall be as a latest IS, also refer control cable specification & Armored cables should be supplied for trench applications.

### ❖ Cable Gland

Double Compression cable glands ( Materials - Brass and Stainless Steel & Suitable for Industrial Grade) of different sizes for cable entry into the RTU,DCU,CRP & Other Panels

### ❖ Cable Trays and NS cable Support

- Perforated / ladder type (galvanized Iron) with cover for laying all type of the cables. Separate tray in trench is required for SCADA Communication Cables.

## 2.2 Multifunction Meters (Accuracy – 0.2)

To extend the current / voltage / active and reactive power, power factor, etc. to RTU, MFMs, to be installed in C & R Panel individually for each feeder/ breakers and should be integrated with RTU. The outputs of these meters (**in groups of 5**) connections should be made using twisted pair screened cable (Typically 22gauge Belden 8761 or equivalent) & two wires (A and B) connections are daisy chained together and integrated with RTUs. All hardware's or protocol converters for having Modbus Protocol output, CT & PT wirings to MFMs and its Configuration should be in Vendor's scope.

For the protection of MFMs and RTU cards against Surges and electrical leakages, it is necessary to install Surge Protection Devices in b/w RTU & MFM serial loops. The typical diagram for this connection is mentioned in the System Architecture diagram. **MFM should be powered through Grid Battery Voltage (220 Volt or 50 Volts DC).**

**The following parameters of MFM must be available for communication with RTU.**

- Phase Voltages (L1-N, L2-N, L3-N)
- Line Voltages (L1-L2, L2-L3, L1-L3)
- Line Currents (IL1 , IL2, IL3)
- Active Power & Reactive Power
- Maximum Demand (KW) & Frequency
- Power factor
- Active Energy
- THD mean current & THD mean Voltage
- Neutral Current.
- Phase Angles

**Approved Makes – RISH 3440 and Conzerv EM 6400NG**

## 2.3 Numerical Relays or Bay Control Protection Units for all feeders (11,33,66KV)

## Chapter 6b. Technical Specification for SCADA interface work & Automation

Numerical Relays(BCPU) shall be integrated with Remote Terminal Units. All hardware's and protocol converters if required for compatibility with SCADA shall be in Vendor's scope.

The respective BCPU(IED) must have **dual redundancy communication ports** (Ethernet/Copper/FO Ports) with **PRP** protocols for SCADA connections & It will be connected to RTU via IEC 61850 protocol. (Dual Ports required to form a **PRP** Networks b/w relay to relay connections).

**Hot Standby/Dual Power Supply Unit** shall be supplied along with BCPU.It will increase the BCPU availability, if any one Power supply card fails the other one should keep the bay control unit continuous live.

Data Base File must be downloadable and Uploadable from BCU.

The following signals are to be taken from Numerical Relays to the BCUs through internal hard wiring. This list is indicative and signals should not be limited to this. Additional signals can be taken during review of actual drawings. – **Refer Para 2.8 for detail signals list with data format (DPI,DCO,SPI,SCO,Measured Values) types.**

- Online Currents / Voltage & Relay General trip signal
- All breaker, Isolators, Control & Relay Panel indications and commands
- Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).
- Fault Differential and Bias current in Line and Transformer Differential Relay
- Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay).
- Post fault currents (R, Y, B phase separately) measured value & Relay Internal Fault
- Fault distance (in case of distance relays - R, Y, B Phase separately)
- Unbalance Current (in case of neutral displacement relay of capacitor feeders).

### 2.4 Transformer Signal - TMD (REGDA, A-EBERLE relays):

OTI, WTI, TPI, AVR and Transformer auxiliary protection signals should be integrated with RTU via IEC 61850 Protocol. TMD must have dual communication ports & have the option of RSTP and PRP Protocols for SCADA Connections.

All field installations of these sensors and its wiring/cabling and configuration along with hardware's or protocol converters, if any, should be in Contractor's scope. - **Refer Para 2.8 for detail signal's list with data types.**

### 2.5 Battery Charger and Lithium Battery Integrations:

All signals of Battery Chargers/Lithium Ion should have MODBUS Protocol output and integrated with an RTU through serial communication (RS 485) cables.

Laying communication cables through conduit pipe and battery charger signals (Soft & Hard Signals) integration with an RTU shall be in Vendor's Scope. - **Refer Para 2.8 for detail Battery Charger signal's list with data types.**

### 2.6 Data Concentrator Unit/Gateway & Remote Terminal Units



## Chapter 6b. Technical Specification for SCADA interface work & Automation

For extending the signals from the grid to the Master Control Centre & Backup Control Centre, BCPUs and RTUs are to be installed. BCPUs needs to be initially physically integrated with Numerical relays of respective breakers to enable soft signals and commands for breakers to be configured there and respectice BCPU integrated with Remote Terminal Units through IEC – 61850 protocol. However the options for IEC-60870-103 protocol along with the MODBUS protocol option is required for other devices integrations. BCPUs can be of **ABB, Siemens, Schneider Electric, GE, etc .**, make is depending on the type/ make of switch gears. **Remote Terminal Units need to be installed for interface between the BCPUs and Control Centers (Main and Backup) through IEC – 60870 – 104 Protocol.** The size of RTU will depend on the size of the substation, no. of the feeders/ number of signals and command outputs along with sufficient spares (20%) for future requirement.

All associated equipments and Supply of accessories including software & Operating tool / multiple user licenses for RTU & BCPU, MCBs for DC and AC Supply, DC to DC Converter (in case station battery voltage level is 220 volts DC), etc. should be in Vendor's scope.

Hardware & software integration of RTUs, BCPU along with other equipments viz. Battery Chargers, Multi Function Meters, Fire Fighting Systems, Signals, Transformer relays (for OTI, WTI, TPI, AVR, etc.), Numerical Relays, etc. should be in Vendor's scope.

In case of more than one BCPU, RTU, DATA Concentrator than these units must be able to communicate with other units on internal local IPs (Ex – 192.168.0.1) other than LAN IP (Ex- 10.125.107.1) series.

Hot redundancy is required for Main Processor cards, rack board, PSU and Gateway for MCC & BCC Communications. Each main processor must have two Ethernet ports dedicated for communication with SCADA servers over IEC 60870-104 protocol. First card will be live and 2nd card will be hot standby. Communication switchover between either cards in case of failure. Main Processor cards along with Rack for MCC communication should be separate from the IO cards.

All cards (IO/Processors/PSU) must have **conformal Coating** to protect against moisture, dust, chemicals and extreme temperatures, etc..

Data Base File must be downloadable and Uploadable from RTU, CPU and Gateway.

**Approved RTU makes – ABB-RTU560, Schneider-SAITEL DP, Siemens A8000 Bidders who are OEM of RTU and Numerical Relays are only acceptable & Pilot (Observation Period – 90 Days with Minimum 90 IED Capacity) with successful test results are main criteria for induction of any new models in BRPL.**

Note : System shall be approved if they are agree to fulfill the following terms & Conditions, It is applicable for all OEM products.

- AMC period should be given 3 years along with this proposal.
- AMC period should be started after handovering the system to BSES.
- During AMC period all the issues pertaining to RTU/Gateway/BCU should be handled by OEM at site (this included unlimited site visit)
- 5 Year replacement warranty is applicable for all OEM for Electronic cards & Gateway Units...If any hardware (or) Software fails during this period will be rectified by OEM.

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- Antivirus/Cyber Security solution for Gateway/RTU unit with 5 years validity need to be considered. Patches updation if any required with in this period is comes under vender scope.
- 5 years warranty is mandatory for all SCADA/RTU products(Electronic cards,GPS,Switches,HMI,etc...).If any cards fails/burnt due to surges from CT,PT via RS485/serial,Surges through cables then replacement will be in your scope up to 5 years. So suitable SPD to be incorporate in the system according to site requirements for avoid card failures.

### RTU,Data Concentrator Unit Features & Performance capabilities

#### 2.6.1 RTU,DCU Size and Expandability

**20% Spare for RTU,DCU** - Provision for 20 % (Basic IO Count +20% Spare) of the total DI / DO signals (hard/soft) as a spare should be made available for future requirement.

**Spare Ports** – 20% Spare ports (**Minimum – 3 to 4 No's Serial ports are essential**) for IEC 103/Mod Bus Protocol Connections

**20% Spare for BCPU** - Each Control and Relay panel BCU must have 20% (Basic + 20% Spare) of the particular bay DI/DO signals as a spare should be available.

**Panel Size & Hardware Capacity** - The RTU panel sizing should be capable of accommodating additional 50% of the basic I/O counts by way of addition of hardware such as modules, racks, panels, Terminal Blocks of basic I/O counts.

**Software Capacity** - The RTU software and database generation should be sized to accommodate for additional 50% of the basic I/O count & No of IED without requiring software or database regeneration or License.

2.6.2 Remote database, downloading of RTU from master station/SCADA control center.

2.6.3 RTU shall have the capability of automatic start-up and initialization following restoration of power after an outage without the need for manual intervention. All restarts shall be reported to the connected master stations.

2.6.4 Act as a data concentrator on IEC60870-5-101/104/MODBUS/IEC 61850 protocols and Support for IEC 60870-5-103, IEC 60870-5-101, IEC 61850,MODBUS TCP IP and RS485 Modbus RTU protocols & ability to act as a gateway for Numerical relays.

#### 2.6.5 Cyber Security

As the SCADA system will use public domain, such LAN/VSAT/GPRS/CDMA etc. therefore it is mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.

2.6.6 Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.

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2.6.7 RTU must have the capability of time synchronization with a GPS receiver and the GPS at the control room will be used for this synchronization purpose. In case of failure of the GPS receiver, the RTUs time synchronization should be through the Master's SCADA clock.

2.6.8 **GPS for Time Synchronization** - The RTU must have inbuilt and external GPS with antenna & internal real time clock to synchronize the IEDs connected to it over their respective protocol. **GPS must have dual redundant LAN port for time synchronizations.**

### **Approved Makes – MASSIBUS & SANDS**

2.6.9 **Main Processor(CPU in RTU & Gateway ) HOT Redundancy for MCC & BCC communication**

Main processor (DCU) /RTU should have adequate capacity for data handling / processing and main processor/CPU must have required number of communication ports for simultaneous communication with Master Stations (MCC & BCC), /MFTs and RTU configuration & maintenance tool.**RTU main processor and Gateway must have HOT redundancy features for control center communications.**

**RTU Processor** must have the capacity of integration of minimum 120 IED's over IEC -61850 Protocol.

2.6.10**Hot Standby/Dual Power Supply Unit & Redundancy in power source for RTU and BCU/BCPU** - Possibility to increase the RTU,BCU main rack availability by having a second power supply card in case the first one fails , **if any one Power supply card fails the other one should keep the system continuous live.**

2.6.11**CPU/RTU Soft Configuration Future (Communicate to multiple master stations simultaneously on IEC60870-5-104.)**

RTU/DAU must have multiple location (minimum 5 Locations) data transmission facility VAZ Master Control Centre, Backup Control Centre, etc.

2.6.12**Protection Devices for RTU,BCPU – All modules (all Digital, Analog Input modules) and ports (Serial and Ethernet ports) must have in-built or external surge protection devices and optical isolation**

2.6.13**Diagnostic Software & Multi user tool/License for RTU/(Numerical Relay) BCU -**

Diagnostic Software tool with licensed version shall be provided to continuously monitor the operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the RTU. **If any system tries to connect to RTU for download/ Upload files,itshould be stored as a log in RTU.**

2.6.14**RTU Panels**

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. The Contractor shall provide required panels conforming to IEC 529

## Chapter 6b. Technical Specification for SCADA interface work & Automation

for housing the RTU modules/racks, relays, Ethernet switches etc. and other required hardware. The panels shall meet the following requirements:

- Shall be free standing, floor mounted and height shall not exceed 2200 mm.
- RTU Panel should have air conditioner and should be mounted on side wall of RTU panel with temperature/humidity control facility. FAN with Filters shall be considered for back up cooling.
- Separate room / Cabinet with AC Provision to be considered for RTU and IT Equipments.
- All doors and removable panels shall be fitted with long life rubber beading.
- All non load bearing panels/doors, top and bottom portion, rear cover shall be fabricated from minimum 2.0 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 3.0 mm thickness steel sheet.
- Shall have maintenance access to the hardware and wiring through lockable full height doors.
- Shall have the provisions for bottom cable entry.
- All panels shall be supplied with 230V AC, 50 Hz, single-phase switch and 15/5A duplex socket arrangement for the maintenance.
- All panels shall be provided with an internal maintenance lamp, space heaters and gaskets.
- All panels shall be indoor, dust-proof with rodent protection, and meet IP54 class of Ingress protection.
- There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
- Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenance register etc.
- All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trims shall be made of flame retardant material and shall not produce toxic gases under fire conditions.

### 2.6.15 RTU Grounding

The safety ground shall be isolated from the signal ground and shall be connected to the ground network. Safety ground shall be a copper bus bar. The contractor shall connect the panel's safety ground to the grid grounding network. Separate grounding (2 Pits) is created for communication equipments and Signal ground shall be connected to the communication equipment signal ground.

### 2.7 Ethernet /Fiber Switch

The Ethernet/Fiber optic switches Should be a managed switch and are intended to be installed in the control room and shall be compliant to IEC-61850 electrical substation networks and IEEE 1613 standards. Provisions for additional feeders on the Ring Configuration should be provided on the same switch.

- Laying of Ethernet/Fiber cables for relay/BCU port to the RTU via switch through conduit pipe and integration with an RTU shall be in Vendor's Scope.

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- Switch, Standard Features
- Switch design should withstand for power substation automation applications that operate in extremely harsh environments (High and medium voltage S/Stn environments) and it also withstands vibration, electrical surges, fast transients, electrostatic discharge, and extreme temperatures and humidity. Industrial managed Fast Ethernet Switch shall be supplied according to IEEE 802.3.
- Switch features and configuration should be easy to user interface and it must directly integrate with any other IEC-61850 devices. Shall be managed type, Layer-2 Switches and have KEMA certifications for IEC 61850.
- The FO switch shall support Multimode fiber and single mode fiber in 100Mbps ports on an SFP (simple form factor pluggable), for ease of functionality and maintenance. 100Mbps ports for sub station level communications & 2 or 4 Gigabit Port for uplink communications.
- ETH Switch PCB/PSU must have **conformal Coating** to protect against moisture, dust, chemicals and extreme temperatures, etc..
- Redundancy Ring : Dual Ring to be considered between Ethernet switches for maintaining redundancy network.
- Hot Standby/Dual PSU & Redundancy in power source - Possibility to increase the switch availability by having a second power source in case the first one fails & should be available with 48VDC. Each PSU should be connected with a different power source, if any one power source or Power supply card fails then other one should keep the switch continuous operation.
- 20% Spare ports - Each switch must have 20% spare ports for future/back up requirements.
- Link Failure contact alarm - Failure contact alarm shall be achieved by hardware contact that is activated when a link problem occurs.
- Logs and alarms with Time Stamp - Statistics about link status alarms are to be stored with the accurate timestamp duly tracing all events.
- Security features - The FO switches shall support different user levels with different passwords, including the facility to work with different VLANs, following the 802.1Q standard, port security based on MAC addresses, possibility to disable unused ports, authentication protocols shall be provided. The FO switches shall have advanced security features to be implemented to avoid unauthorized access to the system Such as RADIUS/TACACS & VPN gateway support with IP Sec & SSH.
- High Speed Implementation of RSTP protocol - The FO switches shall support STP and RSTP protocols, and shall facilitate for recovery and the fault recovery times shall be within 5 -10msec per switch, always fulfilling the RST protocol.
- Time Synchronization to RTU/Server and Connected IED/BCU - The FO switch shall have an internal clock and shall be synchronized from a network SNTP/NTP server, so all time stamped events shall be with a reliable time reference.

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- Tools with License - Diagnostics tool, other necessary tools with a multi user license to be provided along with the switch.
  - Mounting Options - Switch should be DIN Rail Mountable & also need to quote for Optional Wall/Rack Mountable kit.
  - Local USB port for emergency boot is Mandatory.
  - Network based distributed security by having a firewall on each port of the switch for all the standard Industrial protocol like IEC-61850 should be available.
  - The FO switch shall have the facility of Port mirroring and the user shall configure one port to replicate traffic flows of different ports, so the system administrator can monitor the incoming, outgoing, or all kinds of traffic that is going through the ports under study.
  - ITU-T G.8032 support for Ethernet Ring redundancy, ensuring fast failure detection is preferred.
  - They FO switches shall sustain the stringent levels in temperature range and electromagnetic immunity defined in the 61850-3, but also the advanced functional requirements defined for operation with other IEC-61850 devices. The Switch should be certified on IEC-61850, functional & Environmental specifications by KEMA.
  - ETH Switch Panel :
    - ETH Switches & LIU should be fixed in dedicated wall / Floor mountable cabinet in 11kV and 33/66KV CRP Room.
    - Panel must have Sliding tray's for installation of switches.
    - Panel have suitable AC/DC MCB and relevant accessories for supply.
    - All doors and removable panels shall be fitted with long life rubber beading.
    - All non load bearing panels/doors ,top and bottom portion, rear cover shall be fabricated from minimum 2.0 mm thickness steel sheet and all load bearing panels, frames, top & bottom panels shall be fabricated from minimum 2.0 mm thickness steel sheet.
    - Shall have maintenance access to the hardware and wiring through lockable doors.
    - Shall have the provisions for bottom cable entry.
    - All panels shall be supplied with 230V AC, 50 Hz, single-phase switch and 15/5A duplex socket arrangement with an internal maintenance lamp for the maintenance.
    - All panels shall be indoor, dust-proof with rodent protection, and meet IP54 class of Ingress protection.
    - There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
    - All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trims shall be made of flame retardant material and shall not produce toxic gases under fire conditions.
  - Approved Makes of Switches – **RUGGEDCOM & HIRSCHMANN.**
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**2.8 SIGNAL LIST (11/33/66KV)**

List of Abbreviations
AI - Analog Input/Analog Values
MV - Measured Value
MFM - Multi Function Meter
DCO - Double Command Output
DPI - Double Point Indication
SCO - Single Command Output
SPI - Single Point Indication
RTU - Remote Terminal Units
BCU - Bay Control Units

Signals - 11KV Out Going Feeders	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF				√		
Trip Ckt Healthy -1	√				SPI	
Trip Ckt Healthy - 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA				√	SPI	
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
BKR Close COMMAND		√		√	DCO	
BKR Open COMMAND						
AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current & Voltage,Active Power,Reactive Power,Power Factor,Max.Demand,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	10 DI +IGEN DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		

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Essential inbuilt Spare in BCPU	3 DI	2 DO				
Signals - 11KV Incomers	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√	DPI	IEC-61850 with dual Communication Ports
Breaker OFF				√		
Trip Ckt Healthy -1	√				SPI	
Trip Ckt Healthy - 2	√				SPI	
Spring Charge	√				SPI	
Breaker in service					SPI	
Breaker in Test	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
VT fuse Blown - Metering.	√				SPI	
VT fuse Blown - Protection	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local					SPI	
L/R Switch in SCADA	√			√	SPI	
Relay Int Fault.			√		SPI	
Over Current Operated(All stages)	√				SPI	
Earth Fault Operated (All stages)	√				SPI	
Under Voltage Prot.Operated	√				SPI	
Over Voltage Prot.Operated	√				SPI	
REF Operated	√				SPI	
BKR Close COMMAND		√		√	DCO	
BKR Open COMMAND				√		
AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current & Voltage,Active Power,Reactive Power,Power Factor,Max.Demand,Neu.Current	√				AI/MV	
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	12 DI + IGEN Digital+Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU	3 DI	2 DO				



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Signals - 11KV Bus Coupler	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF				√		
Trip Ckt Healthy -1	√				SPI	
Trip Ckt Healthy -2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Auto Trip(86) Operated	√			√	SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				SPI	
L/R Switch in SCADA				√	SPI	
Relay Int Fault.			√		SPI	
PT MCB - Metering operated	√				SPI	
PT MCB - Protection operated	√				SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
BKR Close COMMAND		√		√	DCO	
BKR Open COMMAND						
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI	
Total Signals - BCPU & RTU	10 DI +IGEN DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO				

Signals - 11KV Capacitors	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF				√		
Bank ISO ON	√				DPI	
Bank ISO OFF						
Trip Ckt Healthy -1	√				SPI	
Trip Ckt Healthy -2	√				SPI	
Spring Charge	√				SPI	
Breaker in service	√				SPI	
Breaker in Test					SPI	
Master Trip(86) Operated	√			√	SPI	
Bus PT fuse Blown - Metering.	√				SPI	
Bus PT fuse Blown - Protection	√				SPI	

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Panel DC Fail			√		SPI
L/R Switch in Local	√				SPI
L/R Switch in SCADA	√			√	SPI
Over Current Operated	√				SPI
Earth Fault Operated	√				SPI
Under Voltage Prot.Operated	√				SPI
Over Voltage Prot.Operated	√				SPI
Neg.Phase.sequence Operated	√				SPI
Timer Relay operated/Normal	√				DPI
Relay Int Fault.			√		SPI
BKR Close COMMAND		√		√	DCO
BKR Open COMMAND					
BANK ISO OPN		√			DCO
BANK ISO CLS					
Master trip (86)reset from remote		√			SCO
3Phase R,Y,B - Current&Voltage,Reactive Power,Neu.Current	√				AI/MV
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI
Total Signals - BCPU & RTU	12 DI + IGEN DI+Analog , Measurand Values	5 DO	6DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU	3 DI	2 DO			

Signals - 33 & 66KV Incomers/Out Going	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input/Output Hard Wire to RTU	Additional Spare signals (Hard wire to RTU for backup)	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF						
Front Bus (89A) ISO ON(In-Case of O/D)	√			√	DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√			√	DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
LINE ISO (89L) ON (In-Case of O/D)	√			√	DPI	
LINE ISO (89L) OFF (In-Case of O/D)						
Earth Switch (89LE) -1 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) -1 OFF (In-Case of O/D)						
Earth Switch (89LE) - 2 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) - 2 OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)	√				SPI	
Breaker in Test (In-case of I/D BKR)	√				SPI	

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Trip coil Ckt Healthy - 1	√				SPI		
Trip coil Ckt Healthy - 2	√				SPI		
Spring Charge	√				SPI		
Master trip(86) Operated	√			√	SPI		
SF6 Pressure Low	√				SPI		
SF6 Lock Out	√				SPI		
VT fuse Fail	√				SPI		
Panel DC Fail			√		SPI		
L/R Switch in Local	√				DPI		
L/R Switch in Remote	√			√			
LBB Operated	√				SPI		
Relay Int Fault.			√		SPI		
Over Current Operated (All stages)	√				SPI		
Earth Fault Operated (All stages)	√				SPI		
DIFF.Prot Operated	√				SPI		
DIST.Ptot Operated	√				SPI		
BKR CLS COMMAND		√		√	DCO		
BKR OPN COMMAND				√			
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO		
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)							
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO		
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)							
LINE ISO (89L) OPN COMMAND (In-Case of O/D)		√			DCO		
LINE ISO (89L) CLS COMMAND (In-Case of O/D)							
Master Trip(86) relay reset from Remote		√			SCO		
3Phase R,Y,B -Current&Voltage,Active&Reactive Power,PowerFactor,Max.Demand,Neu.Current etc	√				AI/MV		
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI		
Total Signals - BCPU & RTU	29 DI + IGEN DI+Analog , Measurand Values	9 DO	3DI	8DI + 8 DO			
Essential inbuilt Spare in BCPU	6 DI	3 DO					
<b>Signals - 33 &amp; 66KV Transformer</b>	<b>Digital Input/AI soft through N.Relay/BCPU</b>	<b>Digital Out Put soft through N.Relay/BCPU</b>	<b>Digital Input/Output Hard Wire to RTU</b>	<b>Additional signals Hard wire to RTU for</b>	<b>Signal Type</b>		<b>Protocol</b>

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				backup		
Breaker ON	√			√	DPI	IEC-61850 with dual Communication Ports
Breaker OFF						
Front Bus (89A) ISO ON(In-Case of O/D)	√			√	DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√			√	DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
TRF ISO (89T) ON (In-Case of O/D)	√			√	DPI	
TRF ISO (89T) OFF (In-Case of O/D)						
Earth Switch (89LE) -1 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) -1 OFF (In-Case of O/D)						
Earth Switch (89LE) - 2 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) - 2 OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)	√				DPI	
Breaker in Test (In-case of I/D BKR)						
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
Differential Operated	√				SPI	
LBB Operated	√				SPI	
REF/SEF Prot Operated	√				SPI	
SF6 Pressure Low & SF6 Lock Out	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√		
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						
Trf ISO (89T) OPN COMMAND (In-Case of O/D)		√			DCO	
Trf ISO (89T) CLS COMMAND (In-Case of O/D)						
Mastertrip (86) relay reset from Remote		√			SCO	
3Phase R,Y,B -Current&Voltage,Active&Reactive Power,PowerFactor,Max.Demand,Neu.Current	√				AI/MV	

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Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI
Total Signals - BCPU & RTU	28 DI + IGEN DI+Analog , Measurand Values	9 DO	4DI	8DI + 8 DO	
Essential inbuilt Spare in BCPU	6 DI	3 DO			

Transformer - RTCC/A-Eberle Signals	Digital Input/AI soft through TMM	Digital Out Put soft through TMM	Digital Input/Output Hard Wire to RTU	Analog Input soft through TMM	Signal Type	Protocol
A-Eberle Unit Faulty/DC Fail			√		SPI	IEC-61850 with Dual Communication Ports
Oil Temp Alarm	√				SPI	
Oil Temp trip	√				SPI	
Winding Temp Alarm	√				SPI	
Winding Temp Trip	√				SPI	
Buchholz Alarm	√				SPI	
Buchholz Trip	√				SPI	
PRV TRIP	√				SPI	
OLTC OSR	√				SPI	
MOG/LOW Oil level Alarm	√				SPI	
SPR Trip	√				SPI	
OSR Main Tank	√				SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√					
Auto Mode	√				DPI	
Manual Mode	√					
Fan Fail	√				SPI	
Tap Changer Fail	√				SPI	
OLTC Out of Step/Stuck Up/Motor trip	√				SPI	
Tap Rise/Tap Low Command		√			DCO/RCO	
Tap Rise/Tap Low Command		√				
Oil Temp				√	AI	
Winding Temp				√	AI	
Tap Position				√	AI	
Total Signals - BCPU & RTU	19 DI	2 Command	1 DI	3 Analog , Measurand Values		
Essential inbuilt Spare in BCPU	2 DI	1 DO				

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Signals - 33 & 66KV BusCoupler	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 with Dual Communication Ports
Breaker OFF						
Front Bus (89A) ISO ON(In-Case of O/D)	√			√	DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√			√	DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
Earth Switch (89AE-1) - ON (In-Case of O/D)	√				DPI	
Earth Switch (89AE-1) - OFF (In-Case of O/D)						
Earth Switch (89AE-2) - ON (In-Case of O/D)					DPI	
Earth Switch (89AE-2) - OFF (In-Case of O/D)						
Earth Switch(89BE-3) - ON (In-Case of O/D)	√				DPI	
Earth Switch(89BE-3) - OFF (In-Case of O/D)						
Earth Switch(89BE-4) - ON (In-Case of O/D)					DPI	
Earth Switch(89BE-4) - OFF (In-Case of O/D)						
Breaker in service (In-case of I/D BKR)					DPI	
Breaker in Test (In-case of I/D BKR)	√					
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
SF6 Pressure Low	√				SPI	
SF6 Lock Out	√				SPI	
VT fuse-1 Blown	√				SPI	
VT fuse-2 Blown	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√		
LBB Operated	√				SPI	
Relay Int Fault.			√		SPI	
Over Current Operated (All stages)	√				SPI	
Earth Fault Operated(All stages)	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	
Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)						
AutoTrip(86) relay reset from Remote		√			SCO	
3Phase R,Y,B - Current ,BUS PT-01 & BUS PT02 3Phase votages.	√				AI/MV	

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Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI
Total Signals - BCPU & RTU	31 DI + IGEN DI + Analog , Measurand Values	9 DO	2DI	6DI + 6 DO	
Essential inbuilt Spare in BCPU	6 DI	3 DO			

Signals - 33 & 66KV CAP Bank	Digital Input/AI soft through N.Relay/BCPU	Digital Out Put soft through N.Relay/BCPU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
Breaker ON	√			√	DPI	IEC-61850 With Dual Communication Ports
Breaker OFF						
Front Bus (89A) ISO ON(In-Case of O/D)	√			√	DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)						
Rear Bus (89B) ISO ON (In-Case of O/D)	√			√	DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)						
CAP Bank ISO ON (In-Case of O/D)	√			√	DPI	
CAP Bank ISO OFF (In-Case of O/D)						
Earth Switch ON (In-Case of O/D)	√				DPI	
Earth Switch OFF (In-Case of O/D)						
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Auto Trip(86) Operated	√			√	SPI	
SF6 Pressure Low & SF6 Lock Out of all chambers	√				SPI	
VT fuse Blown	√				SPI	
Cap Discharge Time	√				SPI	
Netural Displacement	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local/Remote	√			√	DPI	
LBB Operated	√				SPI	
Relay Int Fault.			√		SPI	
Over Current Operated	√				SPI	
Earth Fault Operated	√				SPI	
Under Voltage Prot.Operated	√				SPI	
Over Voltage Prot.Operated	√				SPI	
BKR CLS COMMAND		√		√	DCO	
BKR OPN COMMAND				√		
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	
Front Bus (89A) ISO CLS COMMAND (In-Case of O/D)						
Rear Bus (89B) ISO CLS COMMAND (In-Case of O/D)		√			DCO	

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Rear Bus (89B) ISO OPN COMMAND (In-Case of O/D)					
CAP Bank ISO OPN COMMAND ( In-case of O/D)		√			DCO
CAP Bank ISO CLS COMMAND ( In-case of O/D)					
3Phase R,Y,B - Current&Voltage,Reactive Power,Neu.Current	√				AI/MV
Fault current and phase indication of faulty phase viz. R,Y,B, Earth, Unbalance(O/C & E/F Relay).Fault voltage and phase indication of faulty phase viz. R,Y,B (Voltage Protection Relay). Fault Differential and Bias current in Line and Transformer Differential Relay ,Fault distance (in Distance Relay) ,Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI
Total Signals - BCPU & RTU	26 DI + Analog , Measurand Values	9 DO	2DI	10DI + 10 DO	
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO			

Signals - BUS PT-1&2	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input/Output Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	Protocol
BUS A (89A) ON	√			√	DPI	IEC-61850 with Dual Communication Ports
BUS A (89A) OFF						
BUS B (89B) ON	√			√	DPI	
BUS B (89B) OFF						
Earth Switch (89LE) - 1 ON	√				DPI	
Earth Switch (89LE) - 1 OFF						
Earth Switch (89LE) - 2 ON	√				DPI	
Earth Switch (89LE) - 2 OFF						
BUS-A ISO OPN COMMAND		√		√	DCO	
BUS-A ISO CLS COMMAND						
BUS-B ISO OPN COMMAND		√		√	DCO	
BUS-B ISO CLS COMMAND						
Total Signals - BCPU & RTU	8 DI	4 DO		4DI+4DO		
Essential Spare in BCPU	2 DI	1 DO				

Signals - Smoke Detector - ALL Sensors,Manual Call Points Integration with RTU over MODBUS TCPIP Protocol.	Soft Signals	Signal Type	Protocol
All Sensors Alarm operated Signals ( 10 to 20 Sensors)	√	SPI	MODBUS Serial (or)TCP/IP Protocol with Dual Communication Ports
All Manual Call Points - MCP-1,MCP-2.etc...	√	SPI	



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Signals - Battery	Digital Input/AI soft through RTU	AI from Transducer(4 to 20MA) /AI Hard wire signal to RTU	Signal Type	Protocol
<b>Charger</b>				
CHG A AC M/F CUM AC U/V	√		SPI	Modbus Serial Rs485 RTU Protocol with Dual ports
CHG A AC OVER VOLTAGE	√		SPI	
CHG A RECTIFIER FUSE BLOWN	√		SPI	
CHG A FILTER FUSE BLOWN	√		SPI	
CHG A DC MCB TRIP/OFF	√		SPI	
CHG A DC UNDER VOLTAGE	√		SPI	
CHG A DC OVER VOLTAGE	√		SPI	
CHG A FLOAT	√		SPI	
CHG A BOOST	√		SPI	
CHG A DC FAIL	√		SPI	
CHG B AC M/F CUM AC U/V	√		SPI	
CHG B AC OVER VOLTAGE	√		SPI	
CHG B RECTIFIER FUSE BLOWN	√		SPI	
CHG B FILTER FUSE BLOWN	√		SPI	
CHG B DC MCB TRIP/OFF	√		SPI	
CHG B DC UNDER VOLTAGE	√		SPI	
CHG B DC OVER VOLTAGE	√		SPI	
CHG B FLOAT	√		SPI	
CHG B BOOST	√		SPI	
CHG B DC FAIL	√		SPI	
BATTERY MCCB TRIP/OFF	√		SPI	
DC system Earth	√		SPI	
Insulation fault	√		SPI	
Charger A AC INPUT CURRENT	√		AI	
Charger A AC INPUT VOLTAGE	√		AI	
Charger A DC OUTPUT CURRENT	√		AI	
Charger A DC OUTPUT VOLTAGE	√		AI	
Charger B AC INPUT CURRENT	√		AI	
Charger B AC INPUT VOLTAGE	√		AI	
Charger B DC OUTPUT CURRENT	√		AI	
Charger B DC OUTPUT VOLTAGE	√		AI	
Battery Current	√		AI	
Battery Load Voltage	√		AI	
Battery Voltage from Transducer		√	AI	<b>4 to 20 MA O/P</b>
Battery Current from Transducer		√	AI	

Signals - LT Board	Digital Input Hard Wire to RTU	MFM data through Modbus protocol	Signal Type & Meter OP – Modbus with Dual Ports.
LT AC Fail	√		SPI

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R,Y,B Phase Current		√	AI
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Signals - Fire Fighting(All Transformers)	Digital Input Hard Wire to RTU	Signal Type
SYSTEM OPERATED	√	SPI
SYSTEM OUT OF SERVICE	√	SPI
TCIV CLOSED	√	SPI
FIRE DETECTOR TRIP	√	SPI
N2 CYLINDER PRESSURE LOW	√	SPI
FIRE SYSTEM ALARM	√	SPI
DC SUPPLY FAIL	√	SPI

MFM - BUS PT -1 ,2 Signals (Front & Rear BUS)	Data Type	Protocol
R-Phase Current	MV/MFI	Modbus Serial Rs485 RTU
Y-Phase Current	MV/MFI	
B-Phase Current	MV/MFI	
Neutral Current	MV/MFI	
R-Y Phase Voltage	MV/MFI	
Y-B Phase Voltage	MV/MFI	
B-R Phase Voltage	MV/MFI	

MFM - Signals - All Feeders (Including Bus Section/Coupler OF 11/33/66 KV)	Data Type	Protocol
R-Phase Current	MV/MFI	Modbus Serial Rs485 RTU
Y-Phase Current	MV/MFI	
B-Phase Current	MV/MFI	
Neutral Current	MV/MFI	
R-Y Phase Voltage	MV/MFI	
Y-B Phase Voltage	MV/MFI	
B-R Phase Voltage	MV/MFI	
Active Power	MV/MFI	
Active Energy	MV/MFI	
Reactive Power	MV/MFI	
Power Factor	MV/MFI	
Maximum Demand	MV/MFI	
Phase angle 1	MV/MFI	
Phase angle 2	MV/MFI	
Phase angle 3	MV/MFI	
THD Mean Current	MV/MFI	
THD Mean Voltage	MV/MFI	

Note1 : Suitable Heavy Duty Relay /Contactor's with free Wheeling Diode to be placed in between RTU- DO card & Trip/Close Coil circuits of respective breakers for all breaker /Isolator open & Close circuits..It should be placed either at RTU (or) Breaker panel end.Its Potential free contact will be connected in the Closing/Tripping Coil Circuits.

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Note 2: In case of Indoor GIS Panel then all SF6 Low/Lockout of all chamber signals (Approximately 10 to 15 signals per chamber) to be wired up to RTU.

Note 3: PQA (Protocol – Modbus TCP IP/IEC-61850 with dedicated switch to be offered for communication with RTU as well as Router) & Lithium Ion Signal will be finalized at the time of drawing review.

Note 4: All Panels - IRF, DC FAIL SIGNALS can be preferred to terminate with adjacent relays to avoid hard wiring.

### 2.8.1. Comments -

Analog signals (Fault Current levels, Disturbance records, Fault graphs for remote diagnosis, etc.) from Numerical relays needs to be confirmed by vendor before finalizing the tender documents.

All the above mentioned signals (Refer Signal List -2.8) including Notifier /Smoke Detector Signal are compulsory and additional signal (10%) will be considered during detailed engineering.

Following indications data format should be configured as a DPS (Double point Status) in Relay (BCPU).

- All Feeders Circuit Breaker ON & Circuit Breaker OFF
- All Feeders BUS Isolators (89A, 89B, 89L, 89T) - ON & OFF
- All Earth Switches ON & OFF

Following command data format should be configured as a DPC (Double point control) in Relay (BCPU).

- All Feeders Circuit Breaker - Open & Close
- All Feeders BUS Isolators (89A, 89B, 89L, 89T) - Open & Close
- All Earth Switches – Open & Close.

### 3.0 Key Points -

- 1 All SCADA equipments viz DAU / DCU, MFM, Battery Charger, A-Eberle relays, etc. Should be powered through auxiliary supply of 48 V (or) 220 Volt DC.
- 2 Power Supply for Routers/ Gateway (IT Equipments) through an existing battery bank via DC to DC Converters (Input: 48 VDC/220 VDC, Output: 12 Volt DC) or as per the requirements of Routers.

**Converter 01 Specifications : Input 220 Volt DC & Output 12 to 48 Volt DC**

**Converter 02 Specifications: Input 220 Volt DC (or) 48 Volt DC & Output 12 Volt DC**

- 3 Any other wiring / cabling if required due to non availability of serial communication /MODBUS/IEC 61850 protocols (with justified reason) should be hardwired and that is in Contractor's scope.
- 4 All Fire Suppression signals to be considered as a hard wire and terminated up to RTU.

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- 5 Suitable transducers with an output of 4-20 mA have to be installed in the RTCC /Battery charger if required and the outputs of these transducers should be extended to terminal for further extension to the RTU.
  - 6 STATION BUS : Topology
    - IED to Switch : PRP Network/Protocol with CU (or) FO Ports.
    - Redundant Ring with Ethernet/Copper Cable – Switch to Switch & LIU.
    - Redundant Ring with Fiber Optic Cable – From Switch/LIU to RTU/Gateway.
    - Note : Ring Network topology will be decided during the detail engineering stage.
  - 7 The C & R ,RTCC,Battery Charger Panel should have additional spare contacts (potential free) for all SCADA signals – **Refer Signal List 2.8**
  - 8 **Data Base File must be downloadable and Uploadable from RTU,CPU,BCPU,BCU and Gateway.**
  - 9 **Separate Room/Cabinet With AC for RTU and IT Equipments.**
  - 10 **Warranty (5 Years) for SCADA products - All Supplied SCADA material should cover warranty for the duration of 5 years & Warranty period will start after successful commissioning of the SCADA equipments at site. If any SCADA materials found faulty during warranty period should be replaced within two weeks.**
  - 11 **Training at Lab/Factory** should be provided on configuration, installation, commissioning aspects of RTU,DCU,BCPU and Numerical Relay at your training/work center to the BSES SCADA team (4 to 5 persons) at factory/training center(5 days) comes under Vendor's scope.  
Training documents to be submitted for approval & Documents should contain all the necessary installations,connections and Data Base development procedure & further trouble shooting procedure,etc..shall also be provided in the manual.  
**Training at Site:**Vendor shall provide One trainer at site for training after commissioning of SCADA RTU at site.  
.
  - 12 **Spares:** loose Spare Materials for following items with below mentioned quantity to be supplied for emergency back up/maintenance purpose.
    - CPU (Main Processor) with Ethernet Interface Card/Memory in RTU – 1 No
    - CPU(Main Processor Module in BCPU) – 1 No
    - Gateway – 1 No
    - RTU Rack – 1 No
    - BCPU with Rack – 1 No
    - Communication Module for IEC-103 & Modbus Communications with Serial Interface Card/Memory in RTU – 1 No
    - DO Contactots – 10% of supplied qty.
    - DI/DO/AI/ Cards in RTU – 10% of the total IO signals
    - DI/DO/AI/ Cards in BCPU – 10% of the total IO signals
    - PSU Cards in RTU – 1 No
-

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- Ethernet Switches (AS PER SA) – 2 No's
  - LIU Unit – 1 No
  - Fiber Optic Patch Cards with Connectors - 20% of total installed cables.
  - MFM – 5% of Supplied Qty.
  - FO Armored Cable with connectors – 100 Mtrs
  - DC to DC converters if any for RTU Supply – 1 No.
- 13 **Protection devices for all SCADA Equipmentes –**
- Surge Protection devices installation between RTU & MFM Serial loops.
  - SPD for Main DC Source.
  - HDR/Inter Posing Relay for all Digital Output Signal's.
  - All modules (All Digital, Analog Input modules in BCPU and RTU) and ports (Serial and Ethernet ports) must have in-built or external surge protection devices and optical isolation.
- 14 System Architecture : System Architecture should be submitted at the time of tendering process.
- 15 Following tools to be supplied
- laptop 1 No to be supplied with following specification  
Make : Lenova & Model : Think Pad L Series  
10<sup>th</sup> Generation Intel Core TM i5-10210UProcessor(4Cores/8Threads, 1.60-GHZ up to 2.10 GHZ with Turbo Boost, 6MB Casche),Windows 10 Pro 64,  
35.56cms(14.0)FHD (1366x768)TN220nts Anti-glare, 8GB RAM DDR4  
5Years Onsite Warranty,Stereo,Dolby@AudioTM  
65W Adaptor,Carry Bag & Wired Mouse,Integrated Intel@UHD Graphics  
HDMI Port,2xUSB 3.2Gen1, 1xUSB 32 Type-C Gen 1.1xUSB3.2 Type-C Gen2.  
Laptop Battery 3 Cell,45Wh,CAM 720p HD  
Intel Wi-Fi & Blue tooth 5.1
- 16 Drawings/GTP shall be submitted to BRPL-3 Sets hardcopy for approval in the event of award of work.
- 17 As Built Drawings 3 Sets Hard copy and 2 Set in Pen drive shall be submitted at the time of Handover of project for Final billing.
- 18 DB back up along with Software in Pen drive shall be handover at the time of Handover of project for Final billing.
- 19 **All the above features are indicative only and detailed engineering and deviation will be analyzed just before actual procurement and with discussion through a supplier/ vendor.**

### 4.0 System Architecture Diagram

The Tentative System Architecture diagram is enclosed for reference. It will be revised during the approval stage of drawings..

## **Chapter 6b. Technical Specification for SCADA interface work & Automation**

### **5.0 PACKING AND SHIPMENT**

Shall be packed such that protected against corrosion, dampness, heavy rains, breakage and vibration in GPS Enabled Vehicle and shipment status through GPS Device shall be sent to BRPL Project incharge Via SMS/Email.

### **6.0 QUALITY ASSURANCE**

**Factory Acceptance Test** : BRPL executives shall be visiting the vendors factory for inspection of Supply material. Travel Ticket (return flight), local travel, boarding and lodging shall be in vendor's scope.

**Field Quality Plan** : Vendor shall submit a field quality plan for approval of buyer before taking up the execution work at site.

### **7.0 DEVIATIONS**

Deviation from this specification, if any, shall be clearly brought out in the offer. Unless the owner explicitly accepts such deviations, it shall be considered that the offer fully complies with the specification. No deviations will be acceptable post order.

**TECHNICAL SPECIFICATION****FOR****11KV AUTO SWITCHED CAPACITOR BANK  
INDOOR / OUTDOOR TYPE**

Prepared by	Reviewed by	Approved by	Rev	00
			Date	11 Nov 2016
HK	AS	VP	Page	1 of 12

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE****1.0 SCOPE OF SUPPLY**

- a. This specification covers the design, manufacturing, testing, supply, erection & commissioning of 7.2 MVAR (One fixed step of 1.8 MVAR and three steps of 1.8 MVAR) or 3.6 MVAR (One fixed step of 1.8 MVAR and one step of 1.8 MVAR) 11KV three phase outdoor / indoor Auto Switched Capacitor Bank with bus bar arrangement at site for outdoor/indoor installation on structure/panel including but not limited to 0.2% series reactors, capacitor switch/vacuum contactor, motorized isolator cum earth switch, LA, HT fuses, RVT, Automatic power factor controller and all necessary equipment for auto switching.
- b. Each Capacitor Bank shall be fenced as per Civil Specification.
- c. This specification shall be used in conjunction with all specifications, data sheets, single line diagrams, and other drawings attached to the tender.

**2.0 CODES & STANDARDS**

Indian Electricity Rules	
Indian electricity act	
CBIP manual	
IS 13925 part 1,2 & 3	Shunt capacitors above rated voltage 1000v
IS 11298 part 3	Plastic films for capacitors
IS 9921-1985	Isolator
IS 5553	Series reactor
IS 2099	Bushings for voltages above 1000v
IS 12672	Internal fuses & disconnecter for shunt capacitors
IS 2705 & IS3156	Current transformers & RVT
IS 13067	Imp regnant for power capacitors
IS5	Color of mixed paints
IS 15086	Surge arrestor
IS 3070 (Pt 3)	Surge arrestor
IS 2629	Recommended practice for Hot dip galvanizing of steel
IS 4759	Hot dip Zinc coating on Steel structures and other allied products
IEC 60871	Shunt capacitors for AC power Systems
IEC 61000	Automatic Power Factor Controller
IS 9920-2002	Vacuum Contactors/Capacitor Switch



**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows -

- i. Guaranteed Technical Particulars (GTP)
- ii. Specification including applicable codes, standards
- iii. Approved Vendor Drawings
- iv. Other documents

**3.0 SERVICE CONDITIONS**

3.1	Max Ambient Temperature	50 deg C
3.2	Max Daily average ambient temp	40 deg C
3.3	Min Ambient Temp	0 deg C
3.4	Maximum Humidity	95%
3.5	Minimum Humidity	10%
3.6	Maximum annual rainfall	750 mm
3.7	Average no of rainy days per annum	60
3.8	Rainy months	June to Oct
3.9	Altitude above MSL	300 M
3.10	Seismic Zone	IV

**4.0 CAPACITOR BANK**

4.1	Capacitor Scheme	3 Phase, 7.2MVAR @ 11KV (One fixed step of 1.8 MVAR and three steps of 1.8 MVAR) or 3 Phase, 3.6MVAR @ 11KV (One fixed step of 1.8 MVAR and one step of 1.8 MVAR)
4.2	Switching	Auto switching of steps shall be done by capacitor switch/vacuum contactor and controlled by APFC relay mounted in 11kV Capacitor switchgear panel.
4.3	Service location	Suitable for outdoor/Indoor use
4.4	Connection	Refer SLD.
4.5	Residual Voltage Transformer (RVT)	Connect RVT for each step.
4.6	HT capacitor bank assembly	a. Individual single phase capacitor units mounted on steel stand / rack & connected externally by sleeved flexible copper connectors to form double star. b. Sleeves to be Red, Yellow, Blue, & Black in color.
4.7	Interchangeability	Between various single phase capacitor units without disturbing other units
4.8	Enclosure size	To be provided by vendor
4.9	External hardware for HT capacitor bank enclosure (nuts/bolts/handles)	Stainless steel

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

4.10	Series Reactor	Each phase each step shall be provided with suitable series air cored reactor.
4.11	Rated current	The reactor shall be rated for 130% continuous current. The short time rating shall be 16 times the normal current for 2 sec.
4.12	Sizing	Reactors shall be suitably designed to limit overloading due to presence of harmonics in the system as per recommendations of IS13925. Design calculation shall be submitted at the time of drawing approval
4.13	GA drawing	Manufacturer shall submit the G.A. Drawings for Capacitor Bank with mounting of series reactor inside the bank.

**5.0 COMPLETE ENCLOSURE FOR CAPACITOR BANK**

5.1	<b>For Indoor Installation</b>	All the equipments shall be enclosed in the Cubical panel. Panel shall have IP55 Canopy shall be provided over all the panels. Thickness of panel shall be 2.5mm
5.2		There shall be one incomer panel for Isolator and LA. All other panels shall be each of 1.8Mvar. Total 7.2Mvar.
5.3	Bus bar material	Tinned copper, sized for 150% of rated current and rated fault duty
5.4	Bus bar arrangement	Suitable for outdoor termination of HT cable size up to 2 x 3C x 300sqmm for each phase
5.5	Indications on panel Front door	
5.6		Breaker ON
5.7		Breaker Off
5.8		Breaker Trip
5.9		Capacitor Bank ON
5.10		Capacitor Bank OFF
5.11	<b>For Outdoor Installation</b>	
5.12		For enclosing complete capacitor bank including Isolators, LA, cable structure, capacitor units, Reactors, flexible copper connectors, NCT/RVT & terminal bus bar. Enclosures shall be provided with solenoid type interlock switch with timer.
5.13	Enclosure mounting	Free standing on RCC plinth / slab

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

5.14	Enclosure Material	Steel
5.15	Degree of enclosure protection	IP55(In case of Vacuum Contactor Only, Rest must be wire mesh enclosure )
5.16	Enclosure	Wire Mesh Enclosure – Ref.Cl.16 of Technical spec of Civil work
5.17	Bus bar for HV cable termination	One for each phase mounted on porcelain or epoxy insulators
5.18	Bus bar material	Tinned copper, sized for 150% of rated current and rated fault duty
5.19	Bus bar arrangement	Suitable for outdoor termination of HT cable size up to 2 x 3C x 300sqmm for each phase

**6.0 SINGLE PHASE CAPACITOR UNIT**

6.1	Single phase capacitor unit	Totally enclosed, leak proof, dust proof suitable for outdoor application, comprising individual capacitor elements connected in series & parallel groups. Continuous operating current shall be minimum 1.43 times to max. 1.65 times as per clause 6.2 of IS 13925.
6.2	Capacitor unit size	Preferred size is 200kVAR, however higher unit sizes may be considered if the space availability at site is scarce
6.3	Capacitor element	Developed from alternate layers of conducting metal foil & dielectric film
6.4	Conducting layer material	Aluminum foil
6.5	Dielectric material	Hazy Poly Propylene (APP), Double layer minimum
6.6	Cooling	Natural air
6.7	Impregnating liquid	Non PCB(Poly chlorinated Biphenyl), less toxic, with low bio-accumulation and bio-degradable liquid filled under vacuum
6.8	Capacitor unit enclosure	Fabricated from sheet metal CRCA steel of thickness 2mm minimum, hermetically sealed & hydraulically tested
6.9	Discharge device	For each single phase capacitor unit
6.10	Internal fuse	Metal alloy fuse of suitable rating as per IS 12672 should be provided for each capacitor element. Residue of fuse after operation shall not contaminate the impregnating liquid. The fuse shall not deteriorate when subjected to inrush current. The fuse assembly shall be distinct and separate from the element packs such that it shall isolate only the faulty element packs and the operation of a fuse under worst condition

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

		does not affect the other healthy elements.
6.11	Surge arrestor	Gap less metal oxide type
6.12	Rated voltage	9kV
6.13	Maximum continuous operating voltage	7.65kV
6.14	Discharge current	5kA
6.15	Spare capacitor unit	One capacitor unit for each bank

**7.0 RESIDUAL VOLTAGE TRANSFORMER**

7.1	Neutral current transformer	For outdoor/Indoor application, hermetically sealed
7.2	Voltage class	Suitable for system rated voltage
7.3	Ratio	10/1/1
7.4	Accuracy class	0.5 / 5P10
7.5	Burden	15VA / 15VA
7.6	Material	Cast resin
7.7	Mounting	On RCC slab/plinth, near capacitor unit steel stand
7.8	Terminal marking	To be provided on RVT enclosure
7.9	Primary terminals	Brought out of RVT enclosure through insulator bushing of voltage class equal to rated capacitor voltage
7.10	Secondary terminals	Brought out in a terminal box mounted on RVT enclosure
7.11	Secondary terminal box	Suitable for degree of protection IP55 with cable entry for 6c x 2.5sq mm YWY 1100volt grade cable
7.12	Residual Voltage Transformer	Oil Cooled Type
7.13	Connection	Star/Star-Open delta winding ( 11Kv / Sqrt3 : 110V/Sqr 3:190V
7.14	Accuracy Class	0.5/3 PR
7.15	Nominal and Highest System Voltage	11 & 12 kV

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE****8.0 LIGHTNING ARRESTER**

8.1	Installation	Outddoor/Indoor
8.2	Type	Metal Oxide
8.3	Arrestor Rating	9kV (rms)
8.4	Maximum continuous operating voltage	7.65kV (rms)
8.5	Nominal Discharge current	10kA
8.6	Class	Station Class III

**9.0 VACUUM CONTACTOR/SWITCH FOR AUTO SWITCHING**

9.1	Rated Voltages	11 KV
9.2	Rated Continuous Current	200% of full load current (minimum) of unit being switched
9.3	Rated Capacitor Switching Current	150% of full load current (minimum) of unit being switched
9.4	Frequency	50 Hz
9.5	Control supply	230 V Single phase AC supply
9.6	Type	Vacuum
9.7	Installation	Outdoor / Indoor
9.8	Mechanical Endurance	100000 operations (minimum)
9.9	Electrical Endurance	100000 electrical operations at rated capacitive switching current (minimum) without getting damaged.
9.10	Mechanical Indicator	To show number of operations and to show whether the contact is in open/closed position.
9.11	Trip lever	For emergency tripping operation
9.12	Closing lever	For capacitor bank discharging
9.13	Make	ABB/EPCOS/CGL

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE****10.0 SERIES REACTOR**

10.1	Series Reactor	Shall be provided fulfilling following requirement, a. Parallel switching of one bank with another two bank in service b. Suitable design calculation shall be submitted at the time of drawing approval c. Reactors shall be suitably designed to limit inrush current with proper calculation to be submitted to BRPL. d. The series reactor shall be designed to suit the final capacity of Capacitor Bank e. The manufacturer shall submit the G.A. Drawings for Capacitor Bank with mounting of series reactor inside the bank
10.2	Series reactor continuous rating	0.2% of each 1.8Mvar step
10.3	Series reactor rated voltage	Same as capacitor bank rated voltage
10.4	Series reactor rated frequency	50Hz
10.5	Series reactor single phase unit connections	Connected between single phase capacitor units and neutral star point
10.6	Series reactor type	Dry type with air natural cooling
10.7	Series reactor power frequency withstand voltage	28 KV
10.8	Series reactor lightning impulse withstand voltage	75 KV
10.9	Series reactor short time withstand current rating for 3 seconds	16 times capacitor rated current at 130% rated voltage

**11.0 AUTOMATIC CONTROL UNIT**

11.1	<b>General Construction Requirements of Automatic Control Unit</b>	The Automatic control unit shall be provided inside the control room to continuously monitor power factor on secondary side of the transformer and shall automatically switch ON or switch OFF the capacitor banks through the operation of 12Kv Capacitor switch. Overriding provision shall also be made for electrical switching ON & OFF of the capacitor switch by the operator from the ACU control box. The switching ON operation will take place after period of 10 minutes. The switching OFF operation of relevant steps will be instantaneous.
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**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

11.2		<p>The ACU shall instantly switch OFF the incomer VCB of capacitor bank in the following contingencies occurring in any of the phases.</p> <ul style="list-style-type: none"><li>a) Voltage increased by 10% above the rated voltage of 11Kv.</li><li>b) Power transformer current impedance between any of the two phases exceeding 20% of the lowest.</li><li>c) Current increase in any capacitor unit by 30% above the rated current ( only relevant capacitor switch will open)</li><li>d) Current between any of the two phases of the capacitor bank differs more than 15% of the lowest current of the 3 phases (only the relevant capacitor switch will open)</li></ul>
11.3		<p>A suitable display should be provided to indicate the capacitor current in each phases of the complete capacitor bank on the ACU panel inside the control room. Indications shall be provided to indicate ON &amp; OFF status of each capacitor bank.</p> <p>The DC control Voltage for operation of the ACU shall be taken from substation DCDB. The required control voltage shall be either 50VDC or 220VDC.</p>
11.4		<p>Besides in-built protection against lines surges and transient over voltages, suitable fuses/MCB shall be provided for protection against overcurrent. The ACU shall remain fully functional during and after line surges and transient over voltage.</p> <p>Except for the terminal, the ACU shall be enclosed in a suitable casing so as to avoid ingress of dust and should be IP54.</p>

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE****12.0 ISOLATOR**

12.1	Installation	Outdoor / Indoor
12.2	Rated Voltage	11 KV
12.3	Type	Single throw, Double break, off load type, triple pole and horizontal gang operated with earth switch. Mechanical interlock should be provided between isolator and earth switch.
12.4	Operation Type	Manual
12.5	Creepage Distance	31mm/kV

**13.0 PERFORMANCE**

13.1	Over voltage operation	as per IS 13925 part1
13.2	Over current operation	as per IS 13925 part1
13.3	Operating temperature category	+5/C as per IS 13925 part1
13.4	Discharge characteristic as per IS 13925 part1	a. Each capacitor single phase unit residual voltage after disconnection from mains supply shall be 50V (maximum) within 10 minutes b. Capacitor bank residual voltage after disconnection from mains supply shall be 50V (maximum) within 10 minutes
13.5	Power loss and tangent of Loss angle ( $\tan \delta$ )	To be specified by manufacturer as per IS 13925 part1

**14.0 LABELS & FINISH**

14.1	Rating plate for HT Capacitor bank	
	Material	Anodized aluminum 16SWG
14.2	Background	Satin silver
14.3	Letters, diagram & border	Black
14.4	Process	etching
14.5	Bank Name plate details	Mfg name, Mfg Sr. No., Month & year of Mfg, equipment type, total output rating, Bank Capacitance in $\mu$ F, Bank watt losses, Owner name & order number, Temp. category, connection diagram, Guarantee period.
14.6	Unit Name plate details	Mfg name, Mfg Sr. No., Month & year of Mfg, equipment type, total output rating, unit Capacitance in $\mu$ F, unit watt losses, Temp. category, Discharge device rating, connection diagram, Owner name & order number, Guarantee period, unit wt. in kG,



**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR TYPE**

14.7	Danger plate on front & rear side of wired mesh enclosure	Anodized aluminum with white letters on red background
14.8	Painting - Capacitor single phase unit	
14.9	Surface preparation	Shot blasting or chemical 7 tank process
14.10	External finish	Powder coated pure-polyester base Mat finish, shade– Siemens Gray RAL 7032, uniform thickness 50 microns minimum
14.11	Painting– Wire-mesh, frame enclosure	a. Chemical 7 tank process for surface b. Hot dipped Galvanized with uniform thickness 65 microns minimum as per IS 2629 and 4759.

**15.0 INSPECTION & TESTING**

15.1	Type test	Equipment of type tested quality only, type test certificate to be submitted along with offer.
15.2	Routine test	As per relevant Indian standard
15.3	Acceptance test as per IS	To be performed in presence of Owner at manufacturer works, as per relevant Indian standard along with BOM.

**16.0 DEVIATIONS**

Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.

**17.0 TYPICAL SCHEME OF HT CAPACITOR 3 PHASE BANK**

Refer SLD (BRPL-G1DW-DEE-B-001).

**TECHNICAL SPECIFICATION FOR 11 KV AUTO SWITCHED CAPACITOR BANK OUTDOOR / INDOOR  
TYPE****18.0 MANDATORY SPARES**

Following spares have to be provided with capacitor banks

- a. Capacitor Units – 2 nos
- b. Series Reactors – 2 nos
- c. Vacuum Switch – 2 nos



Technical Specification of  
Power Transformer

Specification no – BSES-TS-24-TRPU-R0

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**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****RECORD OF REVISION**

Revision No	Item clause no. /	Nature of Change	Approved By

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****1.0 SCOPE OF SUPPLY**

For scope of supply, refer Annexure A

**2.0 CODES & STANDARDS**

Material, equipment and methods used in the manufacture of power transformer shall conform to the latest edition of following:

IS 2026	Power Transformers
IS 2026-4	Terminal Marking, tappings and Connections for Power Transformers.
IS:3347	Dimensions for Porcelain Transformer bushing
IS:3637	Gas operated relays
IS:3639	Fitting & Accessories for power transformers
IS:4201	Application guide for CT's
IS:8478	Application guide for On-load tap changer
IS:10028	Code of practice for selection, installation & maintenance of transformers
IS 5561	Electrical Power Connectors
IS 5	Colors for ready mix paints
IS:335	Insulating oil
IS 6272	Industrial cooling fans
IS 12615	Three phase induction motors
IS/IEC 60034	Rotating Electrical Machines. (e.g. For Cooler Fan Motors.)
IS/IEC 60071	Co-ordination of Insulation.
IS 16227/IEC 61869	Current Transformers.
IS 8468/ IEC 60214	On Load Tap Changers
IS2026-7/IEC 60076-7	Loading Guide for Oil-Immersed Power Transformers.
IS 2026-8 /IEC 60076-8	Application Guide for Power Transformers.
IS 2026-10/IEC 60076-10	Determination of Transformer Sound Levels.
IS/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code).
IS/IEC 60947	Low-Voltage Switchgear and Control gear.
IS/IEC 60137	Bushing for alternating voltage above 1000V
IS:1271/IEC 60085	Thermal evaluation and classification of electrical insulation
IEC 60076	Power transformers.
IEC 60156	Method for Determination of the Electric Strength for Insulating Oils.
IEC 60296	Specification for Unused Mineral Insulating Oils for Transformers and Switchgear.
IEC 60445	Basic& Safety principles for man-machine interface, marking and identification, Identification of Equipment Terminals and conductor terminals
BS 148	Determination of Transformer and Reactor Sound Levels.

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

BS 223	Application Guide for Power Transformers.
BS 2562	Terminal and Tapping Markings for Power Transformers.
	Indian Electricity Rules
	Indian Electricity Act
	CBIP manual

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows:

- a. Guaranteed Technical Particulars (GTP)
- b. This Specification
- c. Referenced Standards
- d. Approved Vendor Drawings
- e. Other documents

**3.0 MAJOR DESIGN CRITERIA & PARAMETERS OF THE TRANSFORMER**

3.1	Major design criteria	
3.1.1.	Voltage variation on supply side	+ / - 10%
3.1.2	Frequency variation on supply side	+ / - 5%
3.1.2	Transient condition	- 20% or + 10% combined variation of voltage and frequency
3.1.4	Service condition	Refer Annexure C
3.1.5	Insulation level	Refer Annexure C
3.1.6	Short circuit withstand level	Refer Annexure C
3.1.7	Overload capability	Refer Annexure C
3.1.8	Noise level	Refer Annexure C
3.1.9	Radio influence voltage	Refer Annexure C
3.1.10	Harmonic currents	Refer Annexure C
3.1.11	Partial discharge	Refer Annexure C
3.1.12	Parallel operation	Shall be designed to operate in parallel with transformer.
	Major parameters	
	Rating	Refer Annexure C
	Voltage ratio	Refer Annexure C
3.2.3	Vector group	Refer Annexure C
3.2.4	Impedance	Refer Annexure C
3.2.5	Losses	Refer Annexure C
3.2.5.1	No load loss	Refer Annexure C
3.2.5.2	Load losses at principal tap	Refer Annexure C
3.2.6	Temperature rise top oil	Refer Annexure C
3.2.7	Temperature rise winding	Refer Annexure C
3.2.8	Flux density	Refer Annexure C
3.2.9	Current density	Refer Annexure C
3.2.10	Tappings on HV winding	Refer Annexure C
3.2.11	Design clearances	Refer Annexure C

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

**4.0 CONSTRUCTION & DESIGN**

4.1	Type	ONAN/ONAF, Copper wound, three phase, oil immersed with on load tap changer
4.1.1	Essential provision for ONAF cooling	See note 1 of Annexure C
4.1.2	Provision of mounting cooling fan at site in future at service condition.	Required
4.1.3	Provision of replacement of cooling fan at site in future at service condition	Required
4.1.4	Fan guard if fans mounted in future.	Required
4.2	Major parts	
4.2.1	Tank	
4.2.1.1	Material of construction	Robust mild steel plate without pitting and low carbon content
4.2.1.2	Plate thickness	Adequate for meeting the requirements of pressure and vacuum type tests as per CBIP. Test will be conducted on each transformer tank for design validation.
4.2.1.3	Welding features	<ul style="list-style-type: none"> <li>i) All seams and joints shall be double welded</li> <li>ii) All welding shall be stress relieved for sheet thickness greater than 35 mm</li> <li>iii) All pipes, radiators, stiffeners, welded to the tank shall be welded externally</li> </ul>
4.2.1.4	Tank feature	<ul style="list-style-type: none"> <li>i) Adequate space at bottom for collection of sediments</li> <li>ii) Stiffeners provided for rigidity and Designed to prevent accumulation of water</li> <li>iii) No internal pockets in which gas / air can accumulate</li> <li>iv) No external pockets in which water can lodge</li> <li>v) Tank bottom with welded skid base</li> <li>vi) Tank cover sloped to prevent retention of rain water</li> <li>vii) Minimum disconnection of pipe work and accessories for cover lifting</li> <li>viii) Tanks shall be of a strength to prevent permanent deformation during lifting, jacking, transportation with oil filled</li> <li>ix) Tank to be designed for oil filling under vacuum</li> <li>x) Fitted with lifting lug to lift the tank cover only</li> <li>xi) Manhole of sufficient size required for inspection of core and winding</li> </ul>



**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

4.2.1.5	Flanged type adequately sized inspection cover rectangular in shape required for	<ul style="list-style-type: none"> <li>xii) Oil level indicator for transportation</li> <li>i) HV line bushing</li> <li>ii) LV line bushing</li> <li>iii) LV neutral bushing and NCT connection</li> <li>iv) OLTC to winding connection from both sides</li> <li>v) Core assembly ear thing Inspection covers should be provided with jacking screws &amp; handle and shall not weigh more than 25 KG . Overall design shall be in such a way that there shall not be any hindrance/overlapping of some other component, in front of any of the inspection covers.</li> </ul>
4.2.1.6	Fittings and accessories on main tank	See under fittings and accessories
4.2.2	Conservator for the main tank	
4.2.2.1	Capacity	Adequate between highest and lowest visible levels to meet the requirement of expansion of oil volume in the transformer and cooling equipment from minimum ambient temperature to 100 °C
4.2.2.2	Conservator oil preservation system	By flexible rubber bag (air cell) placed inside conservator
4.2.2.3	Air cell material	Special type of fabric coated with special grade nitrile rubber, outer surface oil resistant and inner surface ozone resistant
4.2.2.4	Conservator features	<ul style="list-style-type: none"> <li>i) Conservator shall be bolted into position so that it can be removed for cleaning / other maintenance purposes</li> <li>ii) Main pipe from tank shall project about 20 mm above conservator bottom for creating a sump for collection of impurities</li> <li>iii) Conservator minimum oil level corresponding to minimum temperature shall be well above the sump level</li> <li>iv) It shall be possible to remove and Replace the air cell if required</li> <li>v) Conservator to main tank piping shall be supported at minimum two points.</li> </ul>
4.2.2.5	Fittings and accessories on main tank conservator	<ul style="list-style-type: none"> <li>i) Prismatic oil gauge with NORMAL, MINIMUM and MAXIMUM marking.</li> <li>ii) End cover.</li> <li>iii) Oil filling hole with cap</li> <li>iv) Magnetic oil gauge with LOW LEVEL Alarm contact.</li> <li>v) Silica Gel dehydrating breather with Oil seal and dust filter with clear acrylic single piece clearly transparent cover resistant to UV rays.</li> </ul>

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

		<ul style="list-style-type: none"> <li>vi) Drain cum filling valve (gate valve) with locking rod and position Indicator made of Brass, 25 mm with Cover plate.</li> <li>vii) Shut off valve (gate valve) with position indicator made of Brass Located before and after Buccholz relay, 80 mm.</li> <li>viii) Flange for breather connection.</li> <li>ix) Air release valve on conservator (gate valve) made of Brass, 25 mm with cover plate</li> <li>x) Air release plug as required</li> </ul>
4.2.2.6	Essential provision for mounting of conservator	Conservator to be mounted in such a manner that the top cover of the transformer can be lifted without disturbing the conservator
4.2.2.7	Essential provision for breather	<ul style="list-style-type: none"> <li>i) Breather body should be Aluminum pressure die casted, shot blasted and power coated.</li> <li>ii) Container and oil cup should be 143R grade UV resistant polycarbonate.</li> <li>iii) All gaskets should be of nitrile cork rubber.</li> <li>iv) Breather should be flanged type not threaded type</li> <li>v) Breather piping shall not have any valve placed in between</li> <li>vi) Breather piping from conservator shall be supported in such a manner that the maximum unsupported length of the of the breather piping shall not be more than 3 meters</li> <li>vii) Breather shall be removable type mounted at a height of 1400 mm from ground level.</li> <li>viii) Silica Gel used in breather should be of</li> <li>ix) ROUND BALL type &amp; 2.5 mm dia. Breather shall be tested for 0.35 kg/cm for all joints</li> </ul>
4.2.3	Conservator for OLTC	
4.2.3.1	Capacity	<ul style="list-style-type: none"> <li>i) Adequate between highest and lowest visible levels to meet the requirement of expansion of oil volume in the OLTC from minimum ambient temperature to 100 deg cent. .</li> <li>ii) Separate conservator to be provided for OLTC and Main tank</li> </ul>
4.2.3.2	Conservator oil preservation system	Conventional
4.2.3.3	OLTC conservator features	Same as 4.2.2.4 except air cell features
4.2.3.4	Fittings and accessories on OLTC conservator	<ul style="list-style-type: none"> <li>i) Prismatic oil gauge with NORMAL and MINIMUM marking</li> <li>ii) End cover</li> </ul>

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

		<ul style="list-style-type: none"> <li>iii) Oil filling hole with cap</li> <li>iv) Magnetic oil gauge with LOW LEVEL Alarm contact</li> <li>v) Silica gel dehydrating breather with oil seal and dust filter with clear acrylic single piece clearly transparent cover resistant to UV rays</li> <li>vi) Drain valve (gate valve) With locking rod and position Indicator made of Brass, 25 mm with cover plate</li> <li>vii) Shut off valve (gate valve) with Position indicator made of Brass ocated before oil surge relay, 25 mm</li> <li>viii) Flange for breather connection</li> <li>ix) Air release plug as required</li> </ul>
4.2.3.5	Essential provision for mounting of OLTC conservator	OLTC conservator to be mounted in such a way that the OLTC can be inspected / maintained without disturbing the OLTC conservator
4.2.3.6	Essential provision for OLTC breather	<ul style="list-style-type: none"> <li>i) Breather piping shall not have any valve placed in between</li> <li>ii) Breather piping from conservator shall be supported in such a manner that the maximum unsupported length of the of the breather piping shall not be more than 3 meters</li> <li>iii) Breathers shall be removable type mounted at suitable height from ground so that it can be attended to easily for inspection / maintenance</li> </ul>
4.2.4	Radiators	
4.2.4.1	Material	Pressed Steel
4.2.4.2	Thickness	Minimum 1.2 mm
4.2.4.3	Features	Detachable type with lifting lugs, air release plug, drain plug, isolating valve top and bottom in each radiator, Radiator support from ground if required
4.2.4.4	Essential provision if radiators mounted separately	Expansion bellow to be provided in the pipes between main tank and radiator headers
4.2.4.5	Essential provision for all type of radiators provided	Radiator header pipes shall not originate from tank top cover to make the tank top cover removable at site with minimum manpower.
4.2.5	Core	
4.2.5.1	Material	High grade, non ageing, low loss, high permeability, grain oriented, cold rolled silicon steel lamination
4.2.5.2	Grade	Premium grade minimum M3 or better
4.2.5.3	Lamination thickness	Max. 0.23 mm with insulating coating on both sides
4.2.5.4	Design flux density at rated conditions at principal tap	As per manufacturers design.

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

4.2.5.5	Maximum flux density at 10% over excitation / over fluxing	As per Annexure C , Cl. 35.0
4.2.5.6	Core design features	<ul style="list-style-type: none"> <li>i) Magnetic circuit designed to avoid short circuit paths within core or to the earthed clamping structure</li> <li>ii) Magnetic circuit shall not produce flux components at right angles to the plane of lamination to avoid local heating</li> <li>iii) Least possible air gap and rigid clamping for minimum core loss and noise generation</li> <li>iv) Adequately braced to withstand bolted faults on secondary terminals without mechanical damage and damage / displacement during transportation and positioning</li> <li>v) Percentage harmonic potential with the maximum flux density under any condition limited to avoid capacitor overloading in the system</li> <li>vi) All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling, welding</li> <li>vii) Provision of lifting lugs for core coil assembly</li> <li>viii) Supporting framework designed not to obstruct complete drainage of oil from transformer</li> <li>ix) The insulation of core to bolts and core to clamps plates shall be able to withstand a voltage of 2 kV rms for one minute, however boltless construction shall be preferred to avoid generation of hot spots and decomposition of oil as well as to reduce noise level.</li> </ul>
4.2.6	Winding	
4.2.6.1	Material	Electrolytic Copper
4.2.6.2	Maximum current density allowed	3 A/mm <sup>2</sup>
4.2.6.3	Winding Insulating material	Class A, non catalytic, inert to transformer oil, free from compounds liable to ooze out, shrink or collapse
4.2.6.4	Winding Insulation	Uniform
4.2.6.5	Design features	<ul style="list-style-type: none"> <li>i) Stacks of winding to receive adequate shrinkage treatment before final assembly</li> <li>ii) Connection braced to withstand shock during transport, switching, short circuit, or other transients.</li> <li>iii) Minimum out of balance force in the transformer winding at all voltage ratios.</li> <li>iv) Conductor width on edge exceeding six</li> </ul>

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

		<p>times its thickness</p> <p>v) Transposed at sufficient intervals.</p> <p>vi) Threaded connection with locking facility</p> <p>vii) Winding leads rigidly supported, using guide tubes if practicable</p> <p>viii) Winding structure and major insulation not to obstruct free flow of oil through ducts</p> <p>ix) Provision of taps as indicated in the technical particulars</p>
4.2.6.6	Essential provision for core coil assembly	<p>i) Core coil assembly shall be mounted on bottom of the tank.</p> <p>ii) Earthing of core clamping structure and earthing of magnetic circuit shall be in line with CBIP reference manuals.</p>
4.2.7	Transformer Oil	Should be in accordance with specification as per Annex D of this document.
4.2.8	Bushings and terminations	
4.2.8.1	Type below 52 kV	Oil communicating , outdoor, removable
4.2.8.2	Type 52kv and above	Oil filled porcelain condenser & non oil communicating type with oil level gauge, oil filling plug and drain valve if not hermetically sealed, tap for capacitance and loss factor measurement, removable without disturbing bushing CT'S.
4.2.8.3	Arcing horns.	Not required.
4.2.8.4	Termination on HV side bushing	By bimetallic connectors suitable for ACSR/AAAC conductor, cable connection through cable box with disconnecting link as per annexure A Scope of Supply.
4.2.8.5	Termination on LV side bushing	Cable connection through cable box with disconnecting link as per annexure A, scope supply.
4.2.8.6	Minimum creepage distance of bushing	As per annexure C cl 38.0
4.2.8.7	Protected creepage distance	At least 50 % of total creepage distance
4.2.8.8	Continuous current rating	Minimum 20 % higher than the current corresponding to the minimum tap of the transformer.
4.2.8.9	Rated thermal short time current	As per annexure C Cl 38.0
4.2.8.10	Atmospheric protection for clamp and fitting of iron and steel.	Hot dip galvanizing as per IS 2633
4.2.8.11	Bushing terminal lugs in oil and air.	Tinner copper.
4.2.8.12	Sealing washers /gasket ring.	Nitrile rubber/ Expanded TEFLON(PTFE) as applicable
4.2.9	HV, LV, LV Neutral cable box	Required.
4.2.9.1.1	Material of construction	Sheet steel min 4.0 mm thick. Inspection covers

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

		shall be min 3mm thick.
4.2.9.1.2	Cable box doors (33kV and 11kV Cable boxes)	The doors should be internal anti theft hinge with minimum opening angle of 120°, minimum 3 nos. with lockable handle & with padlocking facility
4.2.9.2	Cable entry	At bottom through detachable gland plate with cable clamps of non magnetic material
4.2.9.3	Cable size for HV	As per annexure C CI 15.1
4.2.9.4	Cable size for LV	As per Annexure C CI 15.2
4.2.9.5	LV Neutral connection	As per Annexure C CI 15.3
4.2.9.6	Detachble gland plate material for HV, LV, LV Neutral box	As per GTP
4.2.9.7	Gland plate thickness for HV, LV, LV Neutral box	As per GTP
4.2.9.8	Cable gland for HV, LV, LV Neutral cables	As per GTP
4.2.9.9	Cable lug for HV& LV cables	As per CL 4.9 of this spec and suitable for cable size as per GTP
4.2.9.10	Essential parts	<ul style="list-style-type: none"> <li>i) Disconnecting chamber</li> <li>ii) Flexible disconnecting link of tinned copper</li> <li>iii) Tinned copper busbar for Owner's cable termination with busbar supports</li> <li>iv) Detachable gland plate as per Schedule A GTP CI. 24.4, 24.5, 25.4, 25.5, 26.4, 26.5</li> <li>v) Earthing boss for the cable box</li> <li>vi) Earthing link for the gasketed joints at two points for each joint</li> <li>vii) Earthing provision for cable armour / screen</li> <li>viii) Flange type Inspection cover with handle for inspecting bushing and busbars on top as well as on front cover</li> <li>ix) Anti theft hinged type door with lockable handle &amp; with padlocking facility for cable box.</li> <li>x) Drain plug</li> <li>xi) Rainhood on gasketed vertical joint</li> <li>xii) Danger plate made of Anodized aluminum with white letters on red background on HV and LV side fixed by rivets.</li> <li>xiii) Phase marking plate inside cable box near termination as well as on front cover of cable box made of anodized aluminum with black letters on satin silver background on HV and LV side fixed by rivets</li> <li>xiv) Support insulators for the busbars shall be epoxy resin cast type.</li> <li>xv) Space heaters for HV and LV cable box controlled by thermostat</li> </ul>

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

4.2.9.11	Terminal Clearances	As per Annexure C technical particulars
4.2.9.12	Termination height required for cable termination	Minimum 1000 mm
4.2.9.13	Essential provision for LV neutral cable box	<ul style="list-style-type: none"> <li>i) Neutral shall be outdoor type bushing OR with cable box. Box shall have adequately sized inspection cover suitable for inspection of bushings / replacement / maintenance of neutral CT. For Outdoor Bushing the NCT shall be mounted in IP55 box.</li> <li>ii) Knife switch with locking arrangement to be provided to disconnect the neutral from grounding. Connection from Neutral bushing to the knife switch shall be with 100x12mm Tinned copper bus bar. Bus Bar shall brought down to the bottom of the transformer supported by suitable support insulator made of epoxy resin cast (insulator shall be suitable for outdoor application suitable for connecting.</li> <li>iii) Knife switch shall be suitable for connecting 2 runs of 75 x 10 mm size GS strip.</li> <li>iv) Height of knife switch shall be at maximum 1500 mm. Housing of Knife switch shall be suitable for easy &amp; quick operations.</li> </ul>
4.2.10	Current Transformers	
4.2.10.1	WTI CT	As per GTP
4.2.10.1.1	Rating	As per GTP
4.2.10.1.2	Mounting	In the turret of the bushing
4.2.10.1.3	Essential provision	<ul style="list-style-type: none"> <li>i) CT mounting shall be such that CT can be replaced without removing tank cover</li> <li>ii) CT secondaries shall be wired upto TB with TB spec. as per Cl. 4.7 of this specification</li> </ul>
4.2.10.2	Neutral CT	
4.2.10.2.1	Type	Cast resin
4.2.10.2.2	Rating	As per GTP
4.2.10.2.3	Location of NCT	Separate box with TB arrangement for secondary Bushing type not acceptable.
4.2.10.2.4	Essential provision	<ul style="list-style-type: none"> <li>i) CT mounting shall be such that CT can be replaced without removing the neutral cable box.</li> <li>ii) CT secondary shall be wired upto TB</li> </ul>
4.2.10.2.5	Size of NCT Box	Overall size of NCT box shall not exceed 1200x600x1000 mm including canopy on top.
4.2.11	Marshalling Box Cubicle	
4.2.11.1	Material of construction	Construction of Marshalling Box should be stainless steel 304 grade (Min) with powder coating of specified color shed
4.2.11.2	Door hinges of marshalling	Required

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	box should be from inner side and should not be exposed to rain.	
4.2.11.3	Major equipments in Marshalling box	<ul style="list-style-type: none"> <li>i) Mechanical gauge for HV and LV WTI</li> <li>ii) Mechanical gauge for OTI</li> <li>iii) Power supply unit (PSU) for remote monitoring of OTI and WTI temperatures. PSU suitable for 48V-265V AC/DC supply.</li> <li>iv) Make of OTI and WTI is Precimeasure 1005AH/1007H model with PSU</li> <li>v) Electronic OTI/WTI Scanner</li> <li>vi) Capillaries for WTI and OTI min 15M length</li> <li>vii) Control &amp; Protection Equipment for Fan Control</li> <li>viii) DC contactors to be provided for all trouble free signals. Same to be wired up to the TB</li> <li>ix) Other panel accessories listed elsewhere</li> </ul>
4.2.11.4	Gland plate	<ul style="list-style-type: none"> <li>i) Min. 3 mm thick detachable with knockout 6 x 1 inch</li> <li>ii) Gland plate mounting should be from inside only</li> </ul>
4.2.11.5	Contacts wired to terminal block	<ul style="list-style-type: none"> <li>i) WTI alarm and trip</li> <li>ii) OTI alarm and trip</li> <li>iii) Buchholz relay alarm and trip</li> <li>iv) OSR trip contacts</li> <li>v) MOG low level alarm</li> <li>vi) MOG on OLTC low level alarm</li> <li>vii) PRV main tank trip</li> <li>viii) PRV OLTC trip</li> <li>ix) Sudden pressure relay trip</li> <li>x) WTI and OTI PSU/ relay contacts of the temperature scanner.</li> <li>xi) Note: 2NO +2NC auxiliary contacts for all the above to be provided for customer use (By using auxiliary relay)</li> </ul>
4.2.11.6	Signals to be wired to terminal block	<ul style="list-style-type: none"> <li>i) WTI CT</li> <li>ii) NCT</li> <li>iii) Capillaries for WTI and OTI</li> <li>iv) 4 to 20 mA signals for WTI and OTI repeater located elsewhere</li> </ul>
4.2.11.7	Ingress protection	IP 55 plus additional rain canopy to be provided
4.2.11.8	Welding	Continuous welding on joints, welding at regular intervals on joints and filling of gaps with use of M seal not accepted
4.2.11.9	Cable entry	Bottom for all cables
4.2.11.10	Panel internal Access	Front only through front door double leaf with antitheft hinges
4.2.11.11	Pane back access	None
4.2.11.12	Mounting of marshalling box	Separately mounted as per GTP
4.2.11.13	Panel supply	415 V AC, Three phase, 50 Hz



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4.2.11.14	Panel accessories	<ul style="list-style-type: none"> <li>i) Cubicle lamp with door switch and separate fuse / MCB</li> <li>ii) Approved space heaters controlled by thermostat and separate fuse / MCB</li> <li>iii) Incoming fuse switch / MCB for the incoming supply</li> <li>iv) Panel wiring diagram fixed on back of panel door on Aluminum plate engraved fixed by rivet</li> <li>v) Stainless steel door handle with lock &amp; additional facility for padlock</li> <li>vi) Earthing boss for the marshaling box</li> <li>vii) Single phase power plug industrial type 15/5 Amp. With MCB</li> <li>viii) Single phase preventer</li> </ul>
4.2.11.15	Painting of marshalling box	As per Cl. 4.10 of the specification
4.2.11.16	Hardware, Gasket, Cables and Wires, Terminal blocks, Cable gland, Cable lugs of marshalling box	As per Cl. 4.3, 4.4, 4.6, 4.7, 4.8, 4.9 of the specification respectively.
4.2.11.17	Fan motors control installed in marshalling box or separate fan control cubicle	<ul style="list-style-type: none"> <li>i) 2 x 50% fans</li> <li>ii) Complete fan control with fuse switch, contactor, Bimetallic relay, in starter circuit with type 2 coordinated rating as per IS</li> <li>iii) Automatic control from WTI contact</li> <li>iv) Provision for manual control both from local/ remote.</li> <li>v) Fan Control Cubicle should be separately mounted.</li> <li>vi) 2RC/2RS type bearings shall be used instead of ball bearings.</li> <li>vii) Fan enclosure shall be perforated sheet with holes at motor side with ground support.</li> </ul>
4.2.11.18	Control Cable Length	All the control Cable shall have minimum 15 Meters of length for all control cable, OTI, WTI Capillaries and NIPFPS control cables also.
4.3	Hardware	
4.3.1	External	M12 size & below Stainless Steel & above M12 Hot Dip galvanized steel.
4.3.2	Internal	Cadmium plated except special hardware for frame parts and core assembly as per manufacturer's design
4.3.3	Provision of fully enclosed Aluminium hoods/Canopy for following accessories of power transformer for protection against water ingress.	All Oil Surge Relays, Buchholz Relay, Pressure release Valve.
4.4	Gasket	
4.4.1	For transformer, OLTC	Nitrile rubber based

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	chamber, PT chamber, surfaces interfacing with oil like inspection cover etc.	
4.4.2	For cable boxes, marshalling box, OLTC drive mechanism etc.	Neoprene rubber based
4.4.3	Tank top cover gasket	It shall be double O ring type sealing arrangement seating over a double groove made in transformer tank & top cover.
4.5	Valves	
4.5.1	Material of construction	Gun metal/Brass
4.5.2	Type	Both end flanged gate valve / butterfly valve depending on application
4.5.3	Size	As per manufacture's standard
4.5.4	Essential provision	Position indicator, locking rod, padlocking facility, valve guard, cover plate.
4.6	Cable routing on Transformer	Control cable for accessories on transformer tank to marshalling box and WTI, OTI Capillaries shall be routed through perforated Covered GI trays
4.6.1	Control cable specification	i) PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100V grade control cable as per latest edition of IS 1554 Part 1 ii) Minimum 2.5 sqmm for signals and 4 sqmm for CT with multistrand copper conductor
4.6.2	Specification of wires to be used inside marshalling box, OLTC drive mechanism.	PVC insulated multistrand flexible copper wires of minimum 2.5 sqmm size, 1100 V grade as per latest edition of relevant IS
4.6.3	Essential provision for Capillary routing from transformer to marshalling box	Routing shall be done in such a way that adequate protection is available from mechanical and fire damage.
4.7	Terminal Blocks to be used by the vendor	Nylon 66 material, minimum 6 sqmm stud type screw driver operated for control wiring and potential circuit. Terminal blocks to be located in such a way to achieve the termination height as min 250 mm from grand plate.
4.7.1	Essential provision for CT terminals	Sliding link type disconnecting terminal block screwdriver operated stud type with facility for CT terminal shorting material of housing melamine/Nylon66
4.8	Cable glands to used by the vendor	Nickel plated brass double compression weatherproof cable gland
4.9	Cable lugs to be used by the vendor	
4.9.1	For power cables	Long barrel medium duty bi-mettalic lug with knurling on inside surface
4.9.2	For control cable	Tinned copper pre insulated Pin Ring, Fork type as applicable. For CT connection ring type lug shall be used.

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4.10	Painting of transformer, conservator, OLTC, Radiator, cable boxes marshalling box.	
4.10.1	Surface preparation	By 7 tank pretreatment process or shot blasting method
4.10.2	Finish on internal surfaces of the transformer interfacing with oil	Bright Yellow heat resistance and oil resistant paint two coats. Paint shall neither react nor dissolve in hot transformer insulating oil.
4.10.3	Frame parts	Bright Yellow heat resistance and oil resistant paint two coats. Paint shall neither react nor dissolve in hot transformer insulating oil.
4.10.4	Finish on inner surface of the marshalling box	White Polyurethane paint anti condensation type two coats, minimum dry film thickness 80 microns
4.10.5	Finish on outer surface of the transformer, conservator, radiator, cable boxes, marshalling box	Smoke Grey (IS shade 692) polyurethane paint two coats, minimum dry film thickness 80 micros

**5.0 MINIMUM PROTECTIVE DEVICES ON TRANSFORMER**

5.1	Spring loaded with detachable diaphragm type pressure relief valve with two trip contacts for the main tank of LSM model with limit switch design IP 65 with additional rain hood. PRV Oil discharge pipe arrangement	Required
5.2	Spring loaded with detachable diaphragm type pressure relief valve with two trip contacts for OLTC of LSM model with limit switch design IP 65 with additional rain hood. Oil discharge pipe arrangement	Required
5.3	Double float buccholz relay with alarm and trip contacts, service and test position, with test cock for the main tank, terminal box shall be IP 65 with drain plug for rainwater draining. Additional rain hood shall be provided.	Reed Switch Type shall be required
5.4	Oil surge relay with two contacts, services and test position, with test cock for OLTC tank, terminal box shall be IP 65 with drain plug for rainwater draining. Additional rain hood shall be provided.	Required
5.5	Sudden pressure relay with trip contact for the main tank	Required

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5.6	Oil temperature indicator metallic bulb type 150 mm diameter with maximum reading pointer, potential free independent adjustable alarm and trip contacts, resetting device with temperature sensing element	Required
5.7	Winding temperature indicator 150 mm diameter with maximum reading pointer, two sets of potential free independent adjustable alarm and trip contacts, resetting device with temperature sensing element, thermal image coil	Required
5.8	2 No's PT 100 sensors/RTDs for winding emperature indication wired upto TB's in marshalling box for external connection.	Required
5.9	Magnetic switching for all the protective devices including Buchholz (alarm and Trip) OSR,SPR,WTI and OTI. Mercury switching is not acceptable	Required

**6.0 FITTINGS AND ACCESSORIES ON TRANSFORMER**

6.1	Rating and diagram plate	Required
6.1.1	Material	Anodized aluminum 16SWG
6.1.2	Background	SATIN SILVER
6.1.3	Letters, diagram & boder	Black
6.1.4	Process	Etching
6.1.5	Name plate details	<p>Following details shall be provided on rating and diagram plate as a minimum</p> <ul style="list-style-type: none"> <li>i) Type / kind of transformer with winding material</li> <li>ii) Standard to which it is manufactured</li> <li>iii) Manufacture's name</li> <li>iv) Transformer serial number</li> <li>v) Month and year manufacture</li> <li>vi) Rated frequency in Hz</li> <li>vii) Rated voltages in kV</li> <li>viii) Number of phases</li> <li>ix) Rated power in kVA</li> <li>x) Type of cooling (ONAN)</li> <li>xi) Rated currents in A</li> <li>xii) Vector group symbol</li> <li>xiii) 1.2/50<math>\mu</math>s wave impulse voltage withstand level in kV</li> <li>xiv) Power frequency withstand voltage in kV</li> </ul>

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		<ul style="list-style-type: none"> <li>xv) Impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap</li> <li>xvi) Load loss at rated current</li> <li>xvii) No load loss at rated voltage and frequency</li> <li>xviii) Auxiliary loss</li> <li>xix) Continuous ambient temperature at which ratings apply in °C</li> <li>xx) Top oil and winding temperature rise at rated load in deg C</li> <li>xxi) Temperature gradient of HV and LV winding</li> <li>xxii) Winding connection diagram</li> <li>xxiii) Weight of radiator</li> <li>xxiv) Volume and weight of oil in radiator</li> <li>xxv) Transport weight of transformer</li> <li>xxvi) Weight of core and frame</li> <li>xxvii) Weight of winding</li> <li>xxviii) Weight of core and winding</li> <li>xxix) Weight of tank and fittings</li> <li>xxx) Total weight</li> <li>xxxii) Volume of oil</li> <li>xxxii) Weight of oil</li> <li>xxxiii) NCT, WCT, details</li> <li>xxxiv) Type of OLTC</li> <li>xxxv) Tapping details</li> <li>xxxvi) Name of the purchaser</li> <li>xxxvii) PO no and date</li> <li>xxxviii) Guarantee period</li> </ul>
6.2	Instruction plate for OLTC anodized aluminum black lettering on satin silver background fixed by rivet	Required
6.3	Oil filling instruction plate anodized aluminum black lettering on satin silver background fixed by rivet	Required
6.4	Valve schedule plate anodized aluminum black lettering on satin silver background fixed by rivet	Required
6.5	Instruction plate anodized aluminum black lettering on satin silver background for flexible air cell for oil conservator	Required
6.6	Terminal marking plate for bushing WTI, OTI & RTD anodized aluminum black lettering on satin silver background fixed by rivet	Required
6.7	Company monogram plate	Required

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6.8	Lifting lugs / bollards with antiskid head to lift complete transformer with oil	Required
6.9	Lashing lug	Required
6.10	Jacking pad with Haulage hole to raise or lower complete transformer with oil	Required
6.10.1	Essential provision for jacking pads. Designed in such a way that jacking of complete transformer with oil shall be possible with 3 nos jacking pads out of 4 nos jacking pads provided as minimum	Required
6.11	Detachable bi-directional roller assembly with corrosion resistant bearing, fitting / nipple for lubrication or with permanently lubricated bearing, anti earthquake locking device. The wheels shall be capable of swiveling when transformer is lifted with provision for locking the swivel movement. Roller shall be suitable for 90 lb rail. Suitable antirolling clamp for 90 lb rail minimum 4 nos. shall be provided	Required
6.12	Pockets for OTI, WTI, & RTD on tank	Required (with one spare pocket for future use)
6.13	Pockets for ordinary thermometer on tank cover, top and bottom header of radiator, top of each radiator	Required
6.14	Ordinary thermometer 4 nos.	Required
6.15	Drain valve (gate valve) for the main tank, 80 mm	Required
6.16	Drain valve (gate valve) for OLTC, 50 mm	Required
6.17	Drain valve (gate valve) for all headers, 50 mm	Required
6.18	Filter valve (gate valve) at top and bottom of the main tank, 50 mm	Required
6.19	Sampling valve (gate valve) at top and bottom of the main tank, 15 mm	Required
6.20	Vacuum breaking valve (gate valve), 25 mm	Required
6.21	Drain plug on tank base	Required
6.22	Air release plug on various fitting and accessories	Required
6.23	Earthing pad on tank for transformer earthing complete with non ferrous nut, bolt, washers, spring washers	Required

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	etc.	
6.24	Vacuum pulling pipe with blanking plate on main conservator pipe work	Required
6.25	Rainhood (canopy) for Bucholz relay, PRV on main transformer and OLTC, OSR relay of OLTC	Required
6.26	Rainhood for vertical gasketed joints, in cable boxes	Required
6.27	Oil level gauge on tank for transformer shipment	Required
6.28	Earthing bridge by copper strip jumpers on all gasketed joints at least two points for electrical continuity	Required
6.29	Aluminium ladder with anticlimbing device and safety flap, with lockable hinged plate for at least 1.5 m from ground level. Ladder shall be located in such a way that it avoids any hindrance to operation of nearby electrical/mechanical accessories etc.	Required
6.30	OLTC panel as specified	Required
6.31	Skid base welded type	Required
6.32	Core, frame to tank earthing	Required
6.33	Danger plate made of anodized aluminium white lettering on red background fixed by rivet	Required
6.34	Identification plate for all accessories, protective devices, instruments, thermometer / RTD pockets, earthing terminals, all inspection covers, cable boxes, marshalling boxes etc.made of anodized aluminium black lettering on silver background fixed by rivet	Required
6.35	Provision for Valves and NRV for mounting of Nitrogen fire protection System	Required
6.36	Separate structure for mounting of cooling fans	Required
6.37	Terminal box of contacts from, Core and Yoke with shorting link at top cover of Transformer	Required. The IR test will be performed on these terminals on trailer prior to unloading at site.
6.38	Aluminum ladder on transformer top cover to conservator top	Required
6.39	Space heaters with thermostat control in HV and LV cable box	Required

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7.0 OLTC

7.1	Requirement	<ul style="list-style-type: none"> <li>i) For 33kV – CTR make EQ16 or equivalent.</li> <li>ii) For 66kV – CTR make FQ 16 or equivalent No in-tank OLTC acceptable.</li> </ul>
7.2	OLTC gear location	Side mounted on conservator side not in front of HV bushing
7.3	Type of OLTC gear	<ul style="list-style-type: none"> <li>i) The tapings shall be controlled by a high speed resistor transition type gear in which tap change is carried out virtually under ‘no volt’ ‘no ampere’ condition and the selector switches do not make and break any current, main current is never interrupted and a resistor is provided to limit the arching at diverter contacts to a minimum suitable for outdoor mounting and continuously rated for operating at all position including positions in the middle of tap change. In particulars, the tap change gear shall be suitable when delivering the full output plus permissible overload and operating the lowest voltage tap on the HV side.</li> <li>ii) The value of the transition resistor shall be indicated on the rating plate of the OLTC with continuous current rating with reference to design ambient temperature specified.</li> </ul>
7.4	Tappings	As per Cl. 34 of Annexure C
7.5	Operation of OLTC gear	Selection of local / remote operation by selector switch on OLTC drive mechanism
7.5.1	local operation	From OLTC drive mechanism through pistol grip rotary switch as well as emergency mechanical hand operation.
7.5.2	Remote operation	From digital RTCC provided by customer /SCADA depending on the selection of control on digital RTCC panel.
7.6	Safety interlocks in OLTC	<p>Following safety interlock to be provided in OLTC as minimum</p> <ul style="list-style-type: none"> <li>i) Positive completion of tap changing step once initiated</li> <li>ii) Blocking of reverse tap change command during a forward tap change already in progress until the mechanism resets and vice – versa</li> <li>iii) Cutting of electrical circuits during mechanical operation</li> <li>iv) Mechanical stops to prevent overrunning of the mechanism at the end taps</li> <li>v) Interlock to avoid continuous tap change</li> </ul>



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		<p>which will cut off motor supply in such events</p> <p>vi) Raise / lower command in OLTC and Digital relay shall be positively interlocked</p>
<p>7.7</p>	<p>Feature of OLTC</p>	<p>i) OLTC mechanism and associated controls shall be housed in an outdoor, IP 55, weatherproof, vermin proof and dust proof cabinet</p> <p>ii) It shall be ensured that oil in compartments containing contacts making and breaking current compartments containing contacts not making and breaking current and main transformer tank does not mix</p> <p>iii) The hand cranking arrangement shall be such that it can be operated at standing height from ground level</p> <p>iv) Mechanical indicator to indicate completion of tap change operation shall be provided with suitable (Green &amp; Red) colour code to confirm correct method of completion of tap change operation</p> <p>v) Contractors shall be placed in the OLTC driving mechanism in such a way that the name-plate shall be visible on opening of door.</p> <p>vi) Protective cover shall be provided for raise and lower push buttons, external ON-OFF switch, which are mounted on OLTC driving mechanism door. This is required to prevent unauthorized person operating these buttons.</p> <p>vii) It shall be possible to remove the top cover of the OLTC tank without difficulty. The OLTC conservator, piping &amp; oil surge relay shall be placed accordingly.</p> <p>viii) The tap change equipment shall be so designed that if the mechanism is struck in an intermediate position, the transformer shall be capable of delivering full load without any damage.</p> <p>ix) Limit switches may be connected in the control circuit of the operating motor provided that a mechanical de-clutching mechanism is incorporated. Otherwise it shall be directly connected to the operating motor circuit and mechanical stop.</p> <p>x) Thermal devices or other means shall be provided to protect the motor and control circuits</p> <p>xi) The tap changer shall be capable of permitting parallel operation with other</p>

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		<p>transformer for which necessary wiring and accessories, if any, shall be provided</p> <p>xii) 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 parallel operation control also at times so that the tap changer will be operated simultaneously when one unit is in parallel with another it will not become out of step and this will eliminate circulating current. Additional features like master /follower and visual indication during the operation of motor shall also be incorporated.</p> <p>xiii) OLTC shall be suitable for bi- directional power flow in transformer</p> <p>xiv) Mechanical indicator and operation counter shall be visible through glass window OLTC drive mechanism door</p> <p>xv) External ON /OFF switch in addition to door switch</p> <p>xvi) All mcb shall be located in such a way that they are easily replaceable.</p> <p>xvii) Motor protection relay shall be provided with single phasing prevent for both current and voltage unbalance.</p> <p>xviii) All accessories inside drive mechanism shall be provided with metallic label, no sticker permitted.</p>
7.8	Essential BOM for OLTC drive mechanism (indicative only, bidder to provide all necessary components to complete the function of the OLTC)	<p>i) Control circuit transformer 415/55-0-55 V, adequate capacity</p> <p>ii) Local remote selector switch 1 pole, 2 way, 6A, pistol grip</p> <p>iii) Retaining switch raise / lower</p> <p>iv) Handle interlock switch</p> <p>v) Raise / lower switch 1 pole, 2way, 6A, pistol grip</p> <p>vi) Lower limit switch</p> <p>vii) Raise limit switch</p> <p>viii) Tap changer motor, 415 V AC, 3 phase, adequate rating</p> <p>ix) Motor protection relay with single phasing preventor</p> <p>x) Motor control contactors raise / lower</p> <p>xi) Stepping relay</p> <p>xii) Out of step switch</p> <p>xiii) Tap position indicator</p> <p>xiv) Operation counter</p> <p>xv) Emergency stop push button</p> <p>xvi) Tap change incomplete scheme with timer</p>

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		xvii) Required indication lamp
7.9	Essential provision of accessories on OLTC	i) Pressure relief valve ii) Oil surge relay
7.10	Drive mechanism accessories	i) Cubical lamp with door switch and separate fuse / MCB with external ON /OFF switch on front cover of OLTC drive mechanism ii) Approved space heaters controlled by thermostat and separate fuse / MCB iii) Incoming fuse switch / MCB for the incoming supply iv) Panel wiring diagram fixed on back of panel door aluminium engraved fixed by rivet v) Nylon 66 terminal block min 4 sqmm screw type, with 10% spare terminals vi) Stainless steel door handle with lock & additional facility for padlock vii) Earthing boss
7.11	Hardware, Gasket, Cables and Wires, Terminal blocks, Cable gland, Cable lugs of OLTC drive mechanism	As per Cl. 4.3, 4.4, 4.6, 4.7, 4.8, 4.9 of the specification respectively.
7.12	OLTC and drive mechanism painting	As per Cl. 4.10 of the specification
7.13	RTCC panel	Not in the scope of supply.

**8.0 APPROVED MAKE OF COMPONENTS**

8.1	CRGO	Nippon/JFE/Posco
8.2	Copper	Birla copper/Sterlite
8.3	Pre compressed Pressboard	Raman Board, Mysore/ Senapathy Whiteley
8.4	Laminated Wood	Permalli Wallance / Rochling Engineers
8.5	Oil	Apar/Savita/Raj
8.6	Condensor Bushings (OIP)	CGL/BHEL/ABB/ALSTOM
8.7	Porcelain Bushing	CJI/Jayshree Insulators/BHEL
8.8	Steel	TATA/Jindal/SAIL
8.9	Lugs/Glands	Jainson/Dowells/Comet
8.10	Radiators	CTR/Hi-Tech Radiators/Tarang Engineers
8.11	Fans	Marathon / Khaitan
8.12	Magnetic Oil Level Indicator	Sukrut /Yogna
8.13	Pressure relief valve	Sukrut / Qualitrol
8.14	Bucchholz Relay	Proyog / ATVUS
8.15	Oil surge Relay	Proyog / ATVUS

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8.16	Winding Temperature Indicator	Precimeasure / Perfect Controls / Pradeep sales
8.17	Oil Temperature Indicator	Precimeasure / / Perfect Controls/ Pradeep Sales
8.18	Sudden Pressure Relay	Sukrut / Qualitrol/ATVUS
8.19	Aircell	Sukrut(Unirub)/Pronol / Rubber Product
8.20	Neutral CT	Pragati /ECS / KAPPA/ Reputed equivalent
8.21	WCT	Pragati / ECS / KAPPA/ Reputed equivalent
8.22	Switch	L&T (Salzer) / Siemens
8.23	HRC Fuse Links	Siemens / L&T/GE
8.24	Fuse base	Siemens / L&T/GE
8.25	AC Contactors & O/L Relay	L&T / Siemens / Schneider
8.26	Terminals	Connectwell / Elmex
8.27	Push buttons / Actuator	L&T / Siemens
8.28	Thermostat	Velco/Girish
8.29	Heater	Velco/Girish
8.30	Voltmeter Selector Switch	Siemens/ equivalent
8.31	Control selector switch	Siemens/ equivalent
8.32	Auxiliary Relays	Jyoti / Easun Rayrole
8.33	Timers	L&T /Siemens
8.34	Tap Position Indicator	Accord
8.35	Annunciator	Accord
8.36	Digital tap change counter	Selectron
8.37	LED cluster type indication lamp	MIMIC/ Siemens/ Binay

Note – Any other make of component to be approved by Owner

**9.0 QUALITY ASSURANCE**

9.1	Quality assurance	To be submitted before contract award. Program shall contain following i) The structure of the organization. ii) The duties and responsibilities assigned to staff ensuring quality of work. iii) The system for purchasing, taking delivery and verification of materials. iv) The system for ensuring quality of workmanship v) The system for control of documentation
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		<ul style="list-style-type: none"> <li>vi) The arrangements for the suppliers internal auditing</li> <li>vii) The system for retention of records.</li> <li>viii) A list of the administration and work procedures required to achieve and verify contracts quality requirements. These procedures shall be made readily available to the purchaser for inspection on request.</li> </ul>
9.2	Quality plan	<p>To be submitted by the successful bidder for approval. Plan shall contain following as a minimum</p> <ul style="list-style-type: none"> <li>i) An outline of the proposed work and programme sequence</li> <li>ii) The structure of the suppliers organization for the contract.</li> <li>iii) The duties and responsibilities assigned to staff ensuring quality of work for the contract.</li> <li>iv) Hold and notification points.</li> <li>v) Submission of engineering documents required by the specification.</li> <li>vi) The inspection of materials and components on receipt</li> <li>vii) Reference to the suppliers work procedures appropriate to each activity</li> <li>viii) Inspection during fabrication /construction.</li> <li>ix) Final inspection and test.</li> <li>x) Successful bidders shall include submittal of Mills invoice, Bill of lading, Mills test certificate for grade, physical tests, dimension, specific watt loss per KG for the core material to the purchaser for verification in the quality plan suitably.</li> </ul>
9.3	Manufacturing environment	<p>Bidder to ensure the following manufacturing areas should be maintain positive atmospheric pressure, clean, dust free (Clean room class ISO 9 or better as per ISO 14644-1) and humid controlled environment.</p> <ul style="list-style-type: none"> <li>i) Insulation storage</li> <li>ii) Core storage</li> <li>iii) Glue stacking area</li> <li>iv) core cutting line</li> <li>v) Winding manufacturing bay</li> <li>vi) Core building area</li> <li>vii) Core coil assembly area</li> <li>viii) Testing lab</li> <li>ix) Packing &amp; dispatch area</li> </ul>
9.4	Accessories environment	<p>Bidder to ensure the following accessories to be kept in clean and coved location</p> <ul style="list-style-type: none"> <li>i) Piping</li> <li>ii) Radiators</li> <li>iii) Tank</li> <li>iv) Bushing (as per manufacturer's guideline)</li> <li>v) Marshalling box</li> <li>vi) Turret</li> </ul>

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		vii) Conservator viii) Insulating oil
9.5	Manufacturing Quality Assurance Plan	Refer Annexure G

**10.0 PROGRESS REPORTING**

10.1	Online document	To be submitted for purchaser approval for outline of production , inspection,testing,packing dispatch ,documentation programme
10.2	Detailed progress report	To be submitted to the purchaser once a month containing i) Progress on material procurement ii) Progress on fabrication iii) Progress on assembly iv) Progress on internal stage inspection v) Reason for any delay in total programme. vi) Details of test failures if any in manufacturing stages. vii) Progress on final box up. viii) Constraints/ Forward path.

**11.0 INSPECTION & TESTING**

11.1	Inspection and Testing during manufacture	
11.1.1	Tank and conservator	i) Check correct dimension between wheels demonstrate turning of wheels through 90 deg and further dimensional check. ii) Check for physical properties of material for lifting lugs, jacking pads etc. all load bearing welds, including lifting lug welds shall be subjected to required load tests iii) Leakage test of the conservator as per CBIP iv) Certification of all test results v) Oil leakage test on all tanks at normal head of oil plus 35 kN / sqm at the base of the tank for 24 hrs vi) Vacuum and pressure test on tank as type test as per CBIP vii) Leakage test of radiators as per CBIP.
11.1.2	Core	The below mentioned core critical points should complied by the bidder
11.1.2.1	Mother Core coil	i) Core material shall be directly procured either from the BSES approved manufacturer or through their authorized service centre/distributor and not through any contractor. ii) Verification & inspection of the mother coil at port & putting stamp & seal may be inspected by BSES.

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11.1.2.2	Core cutting	Bidder should have in house core cutting facility for proper monitoring & control on quality. In case it is done outside cutting shall be done in presence of BSES.
11.1.2.3	Hydraulic core lifting	Bidder should have hydraulic core lifting facility to avoid any jerk at the time of core building
11.1.2.4	Core sample type testing	<p>Reconciliation of mother coil by checking stamp &amp; seal at factory before slitting. One sample of CRGO to be sealed for testing at ERDA/CPRI. Following Tests shall be conducted on the sample per P.O.</p> <ul style="list-style-type: none"> <li>i) Specific core loss measurement</li> <li>ii) Magnetic polarization</li> <li>iii) Magnetic permeability</li> <li>iv) Specific core loss measurement after accelerated ageing test</li> <li>v) Surface insulation resistivity</li> <li>vi) Electrical resistivity measurement</li> <li>vii) Stacking factor</li> <li>viii) Ductility(Bend test)</li> <li>ix) Lamination thickness</li> <li>x) Magnetization characteristics (B-H curve)</li> </ul>
11.1.2.5	Core physical verification	<ul style="list-style-type: none"> <li>i) Check on the quality of varnish if used on the stampings. <ul style="list-style-type: none"> <li>a) Measurement of thickness and hardness of varnish on stampings.</li> <li>b) Solvent resistance test to check that varnish does not react in hot oil.</li> <li>c) Check over all quality of varnish by sampling to ensure uniform hipping colour, no bare spots. No ever burnt varnish layer and no bubbles on varnished surface.</li> </ul> </li> <li>ii) Check on the amount of burns.</li> <li>iii) Bow check on stampings.</li> <li>iv) Check for the overlapping of stampings. Corners of the sheet are to be apart.</li> <li>v) Visual and dimensional check during assembly stage.</li> <li>vi) Check on complete core for measurements of iron-loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.</li> <li>vii) Check for inter laminar insulation between core sectors before and after pressing.</li> <li>viii) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability</li> </ul>

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		<p>of clamps.</p> <p>ix) High voltage test (2 KV for one minute) between core and clamps.</p> <p>x) Certification of all test results.</p>
11.1.2.6	Documents verification	<p>Following documents to be submitted during the stage inspection</p> <p>i) Invoice of supplier</p> <p>ii) Mills test certificates</p> <p>iii) Packing list</p> <p>iv) Bill of lading</p> <p>v) Bill of entry certificates by customs</p>
11.1.3	Insulating material	<p>i) Sample check for physical properties of material</p> <p>ii) Check for dielectric strength</p> <p>iii) Visual and dimensional checks</p> <p>iv) Check for the reaction of hot oil on insulating materials</p> <p>v) Certification of all test results</p>
11.1.4	Windings	<p>i) Sample check on winding conductor for mechanical properties and electrical conductivity</p> <p>ii) Visual and dimensional check on conductor for scratches, dept. mark etc.</p> <p>iii) Sample check on insulating paper for PE value, bursting strength, electric strength</p> <p>iv) Check for the reaction of hot oil on insulating paper</p> <p>v) Check for the binding of the insulating paper on conductor</p> <p>vi) Check and ensure that physical condition of all materials taken for winding is satisfactory and free of dust</p> <p>vii) Check for absence of short circuit between parallel strands</p> <p>viii) Check for Brazed joints wherever applicable</p> <p>ix) Measurement of voltage ratio to be carried out when core / yoke is completely restocked and all connections are ready</p> <p>x) Certification of all test results</p>
11.1.4.1	Checks before drying process	<p>i) Check conditions of insulation on the conductor and between the windings</p> <p>ii) Check insulation distance between high voltage connection cables and earthed and other live parts</p> <p>iii) Check insulation distance between low voltage connection cables and earthed and other parts</p> <p>iv) Insulation test of core earthing</p> <p>v) Check for proper cleanliness</p> <p>vi) Check tightness of coils i.e. no free movements</p> <p>vii) Certification of all test results</p>
11.1.4.2	Checks during drying process	<p>i) Measurement and recording of temperature and drying time during vacuum treatment.</p> <p>ii) Check for completeness of drying</p>



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11.1.5	Oil	iii) Certification of all test result. i) As per IS 335 and annexure-D ii) One sample of oil drawn from every lot of transformer offered for inspection should be tested at CPRI/ERDA for tests as listed under table 1 of IS 1866(2000).The cost of this testing should be included within the cost of transformer. Test result shall be confirming to Annexure D of this specification
11.1.6	Test on fittings and accessories	As per manufacturer's standard
11.2	Routine tests/Acceptance tests	The sequence of routine testing shall be as follows i) Visual and dimension check for completely assembled transformer ii) Measurements of voltage ratio iii) Measurements of winding resistance at principal tap and two extreme taps. iv) Vector group and polarity test v) Measurements of insulation resistance and polarization index. vi) Separate source voltage withstand test. vii) Measurements of iron losses and exciting current at rated frequency and 90%, 100% and 110% rated voltage. viii) Induced voltage withstand test. ix) Load losses measurement. x) Impedance measurement at principal tap (HV and LV) of the transformer. xi) Routine test of tanks xii) Induced voltage withstand test (to be Repeated if type tests are conducted). xiii) Measurement of iron loss (to be repeated if type tests are conducted). xiv) Measurement of capacitance and Tan Delta for for transformer winding and HV bushing (including bushing C1 and C2 Values) and Tan Delta for transformer oil (for all transformers). xv) Phase relation test, polarity, angular displacement and phase sequence. xvi) Ratio of HV WTI CT, LV WTI CT and neutral CT xvii) Excitation and knee point voltage test on class PS core of neutral CT. xviii) Routine test on on-load tap changer. xix) IR test from terminals mentioned in Clause no 6.37 xx) Oil leakage test on assembled transformer xxi) Magnetic balance test xxii) Power frequency voltage withstand test on all auxiliary circuits xxiii) Temperature rise test. xxiv) Certification of all test result

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		<p>xxv) SFRA xxvi) Aircell charging and discharging test</p> <p>a) Insulation resistance measurement shall be carried out at 5 kV. Value of IR should not be less than 2000M ohms. Polarization index (PI = IR10min/IR1min) should not be less than 1.5 (if one minute IR value is above 5000Mohms and it is not be possible to obtain an accurate 10 minutes reading, in such cases polarization index can be disregarded as a measure of winding condition.)</p> <p>b) Temperature rise test may be necessary to be carried out on 100% of the order quantity at the manufacturer's works or third party lab.</p> <p>c) BSES may appoint recognized testing authority like CPRI /ERDA with their instruments &amp; engineer's team and measure no load loss, load loss and percentage impedance of the transformer at supplier's works at Vendor cost . Bidder shall agree and give them full co-operation during their stay &amp; testing at shop floor. The losses &amp; impedance values so obtained will be considered as final.</p>
11.3	Type tests	<p>On one transformer of each rating and type (In Govt. recognized independent test laboratory / Internationally accredited test lab or at manufacturer's facility if it is approved by component authority.</p> <p>i) Impulse withstand test on all three HV and LV limbs of the transformers for chopped wave as per standard</p> <p>ii) Temperature rise test as per IS</p> <p>iii) Dissolved gas analysis before and after Temperature Rise test to be carried out from CPRI/ERDA</p> <p>iv) Pressure relief device test</p> <p>v) Pressure and Vacuum test on tank(stage inspection)</p>
11.4	Special tests	<p>On one transformer of each rating and type</p> <p>i) Dynamic &amp; Thermal short circuit test short circuit test as per IS</p> <p>ii) Measure of zero seq. impedance (Cl.16.10 IS 2026 part-1)</p> <p>iii) 3) measurement of acoustic noise level (Cl.16.12 IS 2026 part-1)</p> <p>iv) Measurement of harmonic level on no load current</p> <p>v) High voltage withstand test shall be performed on the auxiliary equipment and wiring after complete assembly.</p> <p>vi) CRGO testing for specific core loss, accelerated ageing test, surface insulation resistivity, AC permeability and magnetization, stacking factor, ductility etc</p>

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		<p>vii) Oil testing to be tested at CPRI/ERDA labs, whose samples shall be selected &amp; sealed by customer.</p> <p>Cost of such tests, if extra, shall be quoted separately by the bidder.</p>
11.5	In house NABL accreditation	<p>i) Bidder should have in-house NABL accredited testing facility.</p> <p>ii) NABL accreditation certificate to be submitted.</p>
11.6	Note for special tests and type test	<p>Cost of the above tests, if extra, shall be quoted separately by the bidder which shall be considered in the price evaluation.</p>
11.7	Notification to bidders	<p>The product offered must be of type tested design with valid type test report of not more than 5 years.</p> <p>In case the product offered is never type tested for tests as per above list, type tests to be conducted by bidder at his own cost at Govt. recognized independent test laboratory / Internationally accredited test lab or at manufacturer's facility if it is approved by component authority.</p> <p>Valid type test reports for dynamic short circuit test as per IS may be forwarded for customer's review and approval.</p> <p>In case the product offered is never tested for dynamic short circuit the same to be conducted by bidder at his own cost at Govt. recognized independent test laboratory/internationally accredited test lab.</p>
11.7	Site Acceptance test	<p>Following tests shall be conducted at BYPL site/store in presence of BYPL official.</p> <p>i) Insulation Resistance from terminal box mentioned in clause no 6.37. The test shall be conducted on following basis:</p> <p>a) The IR test will be performed on the terminals mentioned in clause no 6.37 on trailer prior to unloading at site.</p> <p>b) The results shall be compared with the results obtained during inspection.</p> <p>c) The IR value in any of the tests (Factory as well as site) should not be less than 2000M Ohm</p> <p>d) To access internal physical damage during transportation, Transformer will not be received if the site results are less than 2000M Ohm.</p> <p>ii) SFRA with same kit done at factory (Instrument shall be in Vendors scope</p> <p>iii) Magnetic Balance test</p> <p>iv) Measurement of Voltage ratio</p> <p>v) Measurement of capacitance and Tan Delta for transformer winding and HV bushing (for all</p>

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		vi) transformers). vii) Vector Group and Polarity viii) Physical checks ix) Oil BDV  Note: Testing instruments shall be in scope of Vendor.
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**12.0 PACKING, SHIPPING, HANDLING AND STORAGE**

12.1	Packing	
12.1.1	Packing protection	Against corrosion, dampness, heavy rains, breakage and vibration.
12.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection
12.1.3	Packing details	On each packing case details required as follows i) Individual serial number: ii) Purchaser's name: iii) PO Number: iv) Destination: v) Suppliers name: vi) Name and address of suppliers agent vii) Description and numbers of contents: viii) Manufacturers name: ix) Country of origin;: x) Case measurements: xi) Gross and net weights in kilograms xii) All necessary slinging and stacking instructions.
12.2	Shipping	The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, roads culverts, overhead lines, free access etc. from the manufacturing plant to project site and furnish to the purchaser confirmation that the proposed packages can be safely transported, as normal or oversize packages up to the plant site. Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the purchaser.
12.3	Handling and storage	As per manufacturers instruction.

**13.0 COMMISSIONING SUPPORT**

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13.1	Commissioning support	Supervision of Erection and Commissioning inclusive of all testing equipments/instruments shall be included for minimum 3 days for each Transformer. It includes following:  i) BSES will give vendor 7 days advance notice prior to erection testing and commissioning of Transformer. ii) After successful erection testing and commissioning of Transformer Vendor shall issue erection quality check certificate to BSES.
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**14.0 TRAINING**

14.1	Training at factory and at site after installation	Training on installation, commissioning, operation and maintenance shall be included in the proposal.
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**15.0 DEVIATIONS**

15.1	Deviation	Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.
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**16.0 DRAWINGS AND DOCUMENTS**

Drawing submission shall be as per the matrix given below. All documents/ drawing shall be provided on A3/A4 sheet in box file with separators for each section. PDF shall also be provided of all documents via USB. Deviation sheet and GTP shall be provided in excel sheet. Language of the documents shall be English only. Deficient/ improper document/ drawing submission may liable for rejection.

S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
1	Copy of specification along with company seal & signature on each page.	✓	✓	
2	Guaranteed technical particulars	✓	✓	
3	Outline dimension drawing for each major component, general arrangement drawing showing component layout an general schematic diagrams.	✓	✓	
4	Type test certificates, where	✓	✓	

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S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
	available, and sample routine test reports			
5	Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating	✓		
6	Details of manufacturers quality assurance standard and programme and ISO 9000 series or equivalent national certification.	✓		
7	Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.	✓		
8	Recommended spare parts and consumable items for the five years of operation with prices and spare parts catalogue with price list for future requirements.	✓		
9	Transport / shipping dimension and weights, space required for handling parts for maintenance	✓		
10	Write up on oil preservation system.	✓	✓	
11	Write up on OLTC.	✓	✓	
12	Quality assurance program.	✓	✓	
13	Programme for production and testing		✓	
14	General description of the equipment and all components, including brochures		✓	
15	Detailed dimension drawing for all components ,general arrangement drawing showing detailed component layout and detailed schematic and wiring drawings for all components like marshalling box and OLTC drive mechanism box.		✓	
16	Calculations to substantiate choice of electrical, structural, mechanical component size, ratings		✓	
17	Detailed loading drawing to enable the purchaser to design and construct foundations for the transformer.		✓	

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S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
18	Transport /shipping dimension with weights ,wheel base details, untanking height etc.		✓	
19	Terminal arrangements and cable box details		✓	
20	Flow diagram of cooling system showing no. of cooling banks		✓	
21	Drawings of major components like bushing,CT etc		✓	
22	Valve schedule diagram plate		✓	
23	Instruction plate for flexible separator		✓	
24	Rating and diagram plate with OLTC connection details		✓	
25	Lists of makes of all fittings and accessories		✓	
26	Statement drawing attention to all exposed points in the equipment at which contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point		✓	
27	Detailed installation and commissioning instructions		✓	
28	Inspection and test reports carried out in manufacturers works			✓
29	Test certificates of all bought out items.			✓
30	Operation and maintenance instructions as well as trouble shooting charts.			✓

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****ANNEXURE – A – SCOPE OF SUPPLY**

Design, manufacture, assembly, testing at stages of manufacture as per Cl. 11 of this specification, final testing at manufacturer works on completely assembled transformer before dispatch, packing, transportation, delivery and submission of all documentation for the Power transformer with all accessories as below and ratings & requirements as specified in Annex C.

<b>Sr No</b>	<b>Description</b>	<b>Scope of Supply</b>
1.0	Fully assembled transformer with all major parts like conservator, Radiators, Marshalling box, Protective devices as per Clause 5.0 of this specification, Fittings and accessories as per Clause 6.0 of this specification	YES
1.1	OLTC as per this specification	YES
1.2	RTCC panel as per this specification	No
1.3	HV, LV ,LV NEUTRAL cable boxes	YES
1.4	Support steel material for support of cable boxes from ground	YES
1.5	Foundation Bolts for complete transformer	YES
1.6	Nickel Plated brass double compression weather proof glands for 33kV cables	YES
1.7	Long barrel medium duty Aluminum lugs for power cables	YES
1.8	Nickel Plated brass double compression weatherproof glands and tinned copper lugs for control cable termination in Marshalling box for vendor's cables	YES
1.9	Cables and wires for transformer accessories and internal wiring of marshalling box.	YES
1.10	Touch up paint, minimum 5 liters.	YES
1.11	Extra Transformer oil 10 % in non returnable drums	YES
1.12	One spare complete set of gaskets.	YES
1.13	One set (4 Nos in a set) of anti rolling clamp for 90 lb rail.	YES
1.14	Ordinary thermometers 4 Nos'	YES
1.15	Recommended spares as per manufacturer	YES
2.0	Routine testing as per Clause 11 of this specification	YES
3.0	Type testing as per Clause 11 of this specification	YES
4.0	Special testing as per Clause 11 of this specification	YES
5.0	Submission of Documentation as per clause 16 of this specification	YES



**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****ANNEXURE – B – SERVICE CONDITIONS**

1.0	Delhi Atmospheric condition	
1.1	Average grade atmosphere	Heavily polluted, dry
1.2	Maximum altitude above sea level	1000M
1.3	Ambient air temperature	50 deg C
1.4	Relative humidity	90% Max
1.5	Seismic zone	4
1.6	Rainfall	750 mm concentrated in four months

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**
**ANNEXURE – C – TECHNICAL PARTICULARS (DATA BY OWNER)**

Sr No	Description	Data by Owner	
1.0	Location of equipment	OUTDOOR	
2.0	Reference design ambient temperature	40 deg C	
3.0	Type	Oil immersed, core type, step down	
4.0	Type of cooling	ONAN / ONAF	
5.0	Reference standard	IS: 2026	
6.0	No. of phases	3	
7.0	No. of winding per phase	2	
8.0	Rated frequency (Hz)	50 Hz	
9.0	Rated voltage (kV)		
9.1	HV winding	33	66
9.2	LV winding	11	11
10.0	Vector group reference	Dyn11	Dyn11
11.0	Nominal continuous rating, KVA		
11.1	For 20/25 MVA		
	ONAN	20	20
	ONAF	25	25
11.2	For 25/31.5 MVA		
	ONAN	25	25
	ONAF	31.5	31.5
12.0	Impedance at principal tap at rated frequency with IS tolerance		
12.1	For 20/25 MVA	15% (for 25MVA)	15% (for 25MVA)
12.2	For 25/31.5 MVA	15% (for 31.5MVA)	15% (for 31.5MVA)
13.0	Maximum no load loss at rated condition allowed without any positive tolerance kW		
13.1	For 20/25 MVA	12kW (for 25 MVA),	12kW (for 25 MVA),
13.2	For 25/31.5 MVA	14 kW (for 31.5 MVA)	14 kW (for 31.5 MVA)
14.0	Maximum load loss at rated condition @ 75 deg C and principal tap allowed without any positive tolerance, kW		
14.1	For 20/25 MVA	85 kW (for 25MVA),	85 kW (for 25MVA),
14.2	For 25/31.5 MVA	115 kW (for 31.5 MVA)	115 kW (for 31.5 MVA)

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15.0	Terminal connection / cable / conductor size		
15.1	HV side	33kV	66 kV
		By 2 runs of 3C X400sq mm A2XFY ,33kV(E) grade cable for 20/25 MVA.	By single /Double ACSR "ZEBRA" conductor per phase
15.2	LV side	1) By 3 runs of 1C x 1000 sqmm per phase A2XY unarmoured cable 11 kV (E) grade cable (For 25MVA)  2) By 4 runs of 1C x 1000 sqmm per phase A2XY unarmoured cable 11 kV (E) grade cable (For 31.5MVA)	
15.3	LV neutral	By G .S. strip min 2x75x10 mm size	By G.S. strip min 2x75x10 mm size
16.0	Highest system voltage HV side, kV	36	72.5
17.0	Highest system voltage LV side, kV	12	12
18.0	Lightning impulse withstand voltage, kV peak		
18.1	For nominal system voltage of 11 kV	75	
18.2	For nominal system voltage of 33 kV	170	
18.3	For nominal system voltage of 66 kV	325	
19.0	Power frequency withstand voltage kV rms		
19.1	For nominal system voltage of 11 kV	28	
19.2	For nominal system voltage of 33 kV	70	
19.3	For nominal system voltage of 66 kV	140	
20.0	Clearances phase to phase, mm		
20.1	For nominal system voltage of 11 kV	280	
20.2	For nominal system voltage of 33 kV	350	
20.3	For nominal system voltage of 66 kV	700	
21.0	Clearances phase to earth, mm		
21.1	For nominal system voltage of 11 kV	140	
21.2	For nominal system	320	

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	voltage of 33 kV	
21.3	For nominal system voltage of 66 kV	660
21.4	Ground clearance – Live part to ground for 66kV – mm	4000
22.0	System fault level, HV side	1500 MVA for 33 kV 3600 MVA for 66 kV
23.0	System fault level, LV side	500 MVA for 11 kV
24.0	Short circuit withstand capacity of the transformer	
24.1	Three phases dead short circuit at secondary terminal with rated voltage maintained on the other side	For 3 secs.
24.2	Single phase short circuit at secondary terminal with rated voltage maintained on the other side	For 3 secs.
25.0	System earthing	
25.1	HV	Solidly earthed
25.2	LV	Solidly earthed
26.0	Overload capability	As per IS 2026 part 7
27.0	Noise level	Shall not exceed limit as per NEMA TR- 1 with all accessories running measured as per IEC 551 / NEMA standard
28.0	Radio influence voltage	Maximum 250 microvolt
29.0	Harmonic suppression	Transformer to be designed for suppression of 3 <sup>rd</sup> , 5 <sup>th</sup> , 7 <sup>th</sup> harmonic voltage and high frequency disturbances
30.0	Partial discharge	10 Pico C
31.0	Temperature rise of top oil by thermometer	40 deg C
32.0	Temperature rise of winding by resistance	45 deg C
33.0	Note for the bidders	(left blank)
34.0	Tapping to be provided on HV winding for OLTC	For 33/11 kV & 66/11kVTransformer +10% to -10% @step of 1.25 % 16 taps, 17 tap positions
35.0	Maximum flux density allowed in the core extreme over excitation /over	1.9 Tesla

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

	fluxing, Tesla	
36.0	Maximum current density allowed	3.0 Amperes per sqmm @ lowest tap.
37.0	AVR input voltage/ Auxiliary supply	Not applicable
38.0	Bushing parameters	
38.1	Rated Current for 20/25 MVA Xmer	1000 A for 33 kV bushing 2000 A for 11kV bushing
38.2	Creepage factor for all bushing mm /KV	31 mm / kV minimum
38.3	Rated thermal short time current for all bushing	25 times rated current for 2 secs
38.4	Angle of mounting	0 to 90 degree
38.5	Cantilever withstand load	for 33 kV bushing- as per std. vendor 2000N for 11kV bushing
38.6	Overall Length (Approx)	for 33 kV bushing- as per std. vendor 503 mm for 11 kV bushing
38.7	Diameter of base	100 mm

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****ANNEXURE – D – TECHNICAL SPECIFICATION FOR TRANSFORMER OIL**

Codes and standards

Latest revision of following codes and standards with all amendments-

Cl no.	Standard no	Title
1.1	IS 335	New insulating oils
1.2	IS1783	Drums for oils

## 2.0 Properties

Sr No	Item description	Specification requirement
<b>2.1</b>	<b>Function</b>	
2.1.1	Viscosity	
2.1.1.1	Viscosity at 40 <sup>o</sup> C	15 mm <sup>2</sup> /s, Max
2.1.1.2	Viscosity at 0 <sup>o</sup> C	1800 mm <sup>2</sup> /s, Max
2.1.2	Pour Point	- 10 <sup>o</sup> C, Max
2.1.3	Water content	30 mg/Kg, Max
2.1.4	Breakdown voltage	
2.1.4.1	New unfiltered oil	30 kV, Min
2.1.4.2	After filtration	70 kV, Min
2.1.5	Density at 20 <sup>o</sup> C	0.895 g/ml, Max
2.1.6	Dielectric dissipation factor at 90 <sup>o</sup> C	0.005, Max
2.1.7	Particle Content	Manufacturer to specify the data
<b>2.2</b>	<b>Refining/Stability</b>	
2.2.1	Appearance of oil	Clear, free from sediment and suspended matter
2.2.2	Acidity	0.01 mg KOH/g, Max
2.2.3	Interfacial tension at 27 <sup>o</sup> C	0.04 N/m, Min
2.2.4	Total sulphur content	Manufacturer to specify the data
2.2.5	Corrosive sulfur	Not-corrosive
2.2.6	Potentially Corrosive sulfur	Not-corrosive
2.2.7	DBDS	Not detectable (<5 mg/kg)
2.2.8	Inhibitor	Not detectable (<0.01%)
2.2.9	Metal Passivator	Not detectable (<5 mg/kg)
2.2.10	Other additives	Manufacturer to specify the data
2.2.11	2-furfural and related Compounds content	Not detectable (<0.05 mg/kg) for each individual compound
<b>2.3</b>	<b>Performance</b>	
2.3.1	Oxidation stability, test duration 164 h	
2.3.1.1	Total acidity	1.2 mg KOH/g, Max
2.3.1.2	Sludge	0.8%, Max
2.3.1.3	DDF at 90 <sup>o</sup> C	0.5, Max
2.3.2	Gassing Tendency	Manufacturer to specify the data
2.3.3	ECT	Manufacturer to specify the data



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<b>2.4</b>	<b>Health,safety and Environment</b>	
2.4.1	Flash point	135 <sup>0</sup> C, Min
2.4.2	PCA content Max	3%, Max
2.4.3	PCB content	Not detectable (<2 mg/Kg)

**ANNEXURE – E – SPECIFICATION FOR NITROGEN INJECTION FIRE PROTECTION SYSTEM****1.0.0 SUPPLY AND SCOPE WORK**

Design, manufacture, testing of the assembled system at manufacturer's works before dispatch, packing and supply at site, erection and commissioning of the Nitrogen Injection Fire Protection system

Installation testing and commissioning of Nitrogen Injection Fire Protection system shall be in scope of bidder. All material including Pipes, ducts control cables, tools, tackles, hardware, testing equipments and manpower required for the work shall be in scope of bidder except for any type of civil work like fire wall, soak pit etc. Bidder if feels shall conduct physical survey of the power transformer to check feasibility and quantum of work involved.

**2.0.0 INTRODUCTION**

Nitrogen Injection Fire Protection System (NIFPS) shall use nitrogen as fire quenching medium. The protective system shall prevent transformer / Reactor oil tank explosion and possible fire in case of internal faults. In the event of fire by external causes such as bushing fire, OLTC fires, fire from surrounding equipment etc, it shall act as a fast and effective fire fighter without any manual intervention. It shall accomplish its role as fire preventer and extinguisher without employing water and / or carbon dioxide.

Fire shall be extinguished within 3 minutes (Maximum) of system activation and within 30 seconds (maximum) of commencement of nitrogen injection.

**3.0.0 APPLICABLE CODES AND STANDARDS**

The design and installation of the complete fire protection system shall comply with the latest applicable Indian standards

- a) IS 10028 (Part II) : Code of practice for selection, installation, and maintenance of transformer
- b) Tariff Advisory Committee : Regulations for the electrical equipment of buildings
- c) National fire Codes 1993 of National Fire Protection Association (NFPA) USA
- d) Central Electricity Authority, The Gazette of India, Extraordinary 2010 : Safety provisions for electrical installations and apparatus of voltage exceeding 650V

**4.0.0 ACTIVATION OF THE FIRE PROTECTIVE SYSTEM**

Mal-functioning of fire prevention / extinguishing system could lead to interruption in power supply. The supplier shall ensure that the probability of chances of malfunctioning of the fire protective system is practically zero. To achieve this objective, the supplier shall plan out his scheme of activating signals which should not be too



**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

complicated to make the fire protective system inoperative in case of actual need and should not be dependent on auxiliary power source. The system shall be provided with automatic control for fire prevention and fire extinction without any manual intervention. Besides automatic control, remote electrical push button control at Control box and local manual control in the fire extinguishing cubicle shall also be provided. The following electrical-signals shall be required for activating the fire protective system under prevention mode / fire extinguishing mode.

**4.1.0 Auto Mode****4.1.1 For prevention of fire :**

Differential relay operation + Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay) + Tripping of all or one circuit breakers (on HV & LV/IV side) associated with transformer / reactor is the pre-requisite for activation of system. The system shall have sufficient Input modules.

**4.1.2 For extinguishing fire :**

Fire detector + Buchholz relay paralleled with pressure relief valve (PRV) or sudden pressure relay (SPR) + tripping of all circuit breakers (on HV & LV/IV side) associated with transformer / reactor is the pre-requisite for activation of system.

**4.2.0 Manual Mode (Local / Remote electrical)**

Tripping of all circuit breakers (on HV & LV/IV side) associated with transformer/reactor is the pre-requisite for activation of system.

**4.3.0 Manual Mode (Mechanical)**

Tripping of all circuit breakers (on HV & LV/IV side) associated with transformer / Reactor is the pre-requisite for activation of system.

The system shall be designed to be operated manually in case of failure of power supply to fire protection system.

**5.0.0 GENERAL DESCRIPTION**

Nitrogen injection fire protection system should be a dedicated system for each oil filled transformer / reactor. It should have a Fire Extinguishing Cubicle (FEC) placed on a plinth at 5-7m away (as per statutory requirement) from transformer / reactor or placed next to the fire wall if fire wall exists. The FEC shall be connected to the top of transformer / reactor oil tank for depressurization of tank and to the oil pit as per Indian standard and CBIP from its bottom through oil pipes. The fire extinguishing cubicle should house a pressurized nitrogen cylinder(s) which is connected to the oil tank of transformer/reactor oil tank at bottom. The Transformer Conservator Isolation Valve (TCIV) is fitted between the conservator tank and Buchholz relay.

Cable connections are to be provided from signal box to the control box in the control room, control box to fire extinguishing cubicle, TCIV to signal box and any other wiring to ensure proper functioning of the fire protection system. Fire detectors placed on the top of transformer/reactor tank are to be connected in parallel to the signal box by Fire survival cables. Control box is also to be connected to relay panel in control room for

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

receiving system activation signals. All panel or control equipments shall be fire proof so as to ensure that they do not fail themselves in event of fire.

**6.0.0 OPERATION**

On receipt of all activating signals, the system shall drain pre-determined volume of hot oil from the top of tank (i.e top oil layer), through outlet valve, to reduce tank pressure by removing top oil and simultaneously injecting nitrogen gas at high pressure for stirring the oil at pre-fixed rate and thus bringing the temperature of top oil layer down. Transformer conservator isolation valve blocks the flow of oil from conservator tank in case of tank rupture / explosion or bushing bursting. Nitrogen occupies the space created by oil drained out and acts as an insulating layer over oil in the tank and thus preventing aggravation of fire.

**7.0.0 SYSTEM COMPONENTS**

Nitrogen injection fire protection system shall broadly consist of the following components. However, all other components which are necessary for fast reliable and effective working of the fire protective system shall be deemed to be included in the scope of supply.

**7.1.0 Fire Extinguishing Cubicle (FEC)**

The FEC shall be made of CRCA sheet of 3 mm (minimum) thick complete with the base frame, painted inside and outside with post office red colour (shade 538 of IS-5). It shall have hinged split doors fitted with high quality tamper proof lock. The degree of protection shall be IP55. The following items shall be provided in the FEC.

- a. Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer
- b. Oil drain pipe with mechanical quick drain valve.
- c. Control equipment for draining of oil of pre-determined volume and injecting regulated volume of nitrogen gas
- d. Pressure monitoring switch for back-up protection for nitrogen release
- e. Limit switches for monitoring of the system
- f. Butterfly valve with flanges on the top of panel for connecting oil drain pipe and nitrogen injection pipes for transformer/reactors
- g. Panel lighting (CFL Type)
- h. Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.

**7.2.0 Control box**

Control box is to be placed in the control room for monitoring system operation, automatic control and remote operation. Control supply will be 50/220VDC (15% tolerance) based on site requirement. The following alarms, indications, switches, push buttons, audio signal etc. shall be provided.

- a. System on
- b. TCIV open
- c. Oil drain valve closed
- d. Gas inlet valve closed
- e. TCIV closed\*

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- f. Fire detector trip \*
- g. Buchholz relay trip
- h. Oil drain valve open\*
- i. Extinction in progress \*
- j. Cylinder pressure low \*
- k. Differential relay trip
- l. PRV / SPR trip
- m. Master relay of Transformer/reactor trip
- n. System out of service \*
- o. Fault in cable connecting fault fire detector
- p. Fault in cable connecting differential relay
- q. Fault in cable connecting Buchholz relay
- r. Fault in cable connecting PRV / SPR
- s. Fault in cable connecting transformer /reactor trip
- t. Fault in cable connecting TCIV
- u. Auto/ Manual / Off
- v. Extinction release on / off
- w. Lamp test
- x. Visual/ Audio alarm\*
- y. Visual/ Audio alarm for DC supply fail \*

Suitable provision shall be made in the control box, for monitoring of the system from remote substation using the substation automation system.

### **7.3.0 Transformer Conservator Isolation Valve**

Transformer conservator isolation valve (TCIV) to be fitted in the conservator pipe line, between conservator and buchholz relay which shall operate for isolating the conservator during abnormal flow of oil due to rupture / explosion of tank or bursting of bushing. The valve shall not isolate conservator during normal flow of oil during filtration or filling or refilling, locking plates to be provided with handle for pad locking. It shall have proximity switch for remote alarm and indication glass window for visual inspection for physical checking of the status of valve.

The TCIV should be of the best quality as malfunctioning of TCIV could lead to serious consequence. The closing of TCIV means stoppage of breathing of transformer/reactor. Fire survival cable connecting TCIV shall be terminated in transformer marshalling box.

### **7.4.0 Fire detectors**

The system shall be complete with adequate number of fire detectors (quartz bulb) fitted on the top cover of the transformer / reactor oil tank. The system generates signal after sensing higher temperature. The placing of fire detectors and numbers shall be designed and finalized by bidder as per requirement.

### **7.5.0 Signal box**

It shall be mounted away from transformer / reactor main tank, preferably near the transformer marshalling box, for terminating cable connections from TCIV & fire detectors and for further connection to the control box. The degree of protection shall be IP55.

### **7.6.0 Cables**

Fire survival cables (capable to withstand 750° C.) of 4 core x 1.5 sq. mm size for connection of fire detectors in parallel shall be used. The fire survival cable shall conform to BS 7629-1, BS 8434-1, BS 7629-1 and BS 5839-1, BS EN 50267-2-1 or relevant Indian standards.

Fire Retardant Low Smoke (FRLS) cable of 12 core x 1.5 sq. mm size shall be used for connection of signal box / marshalling box near transformer/reactor and FEC mounted near transformer/reactor with control box mounted in control room.

Fire Retardant Low Smoke (FRLS) cable of 4 core x 1.5 sq. mm size shall be used for connection between control box to DC and AC supply source, fire extinguishing cubicle to AC supply source, signal box/ marshalling box to transformer conservator isolation valve connection on transformer/reactor.

### **7.7.0 Pipes**

Heavy duty pipe connecting the transformer/reactor tank for oil drain, and for nitrogen injection shall be provided. Pipes connecting oil tank laid underground, shall be preferably be used for interconnection. Pipes, complete with connections, flanges, bends and tees etc. shall be supplied along with the system.

### **7.8.0 Other items**

- 7.8.1 Oil drain and nitrogen injection openings with gate valves on transformer / reactor tank at suitable locations.
- 7.8.2 Flanges with dummy piece in conservator pipe between Buchholz relay and conservator Tank for fixing TCIV.
- 7.8.3 Fire detector brackets on transformer / reactor tank top cover.
- 7.8.4 Spare potential free contacts for activating the system i.e. in differential relay, Buchholz relay, Pressure Relief Device / RPRR, Circuit Breaker of transformer/reactor
- 7.8.5 Pipe connections between transformer / reactor and FEC and between FEC and oil pit required for collecting top oil.
- 7.8.6 Cabling for fire detectors mounted on transformer /reactor top cover
- 7.8.7 Inter cabling between signal box, control box and Fire Extinguishing Cubicle (FEC).  
All external cables from / to the system i.e. signal box to control box and control box to FEC shall be provided by the purchaser. All internal cables within the system i.e. between detectors / signal box / marshalling box / FEC / TCIV shall be in the scope of NIFPS supplier.
- 7.8.8 Butterfly valves /Gate valves on oil drain pipe and nitrogen injection pipe which should be able to withstand full vacuum.
- 7.8.9 Supports, signal box etc. which are to be painted with enamelled paint.
- 7.8.9 The doors, removable covers and panels shall be gasketed all round with neoprene gaskets.

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****8.0.0 MANDATORY SPARES**

Cylinder filled with Nitrogen of required capacity per substation	1 No.
Fire Detectors per transformer	3 No's.
Regulator assembly per sub-station	1 No.

**9.0.0 TESTS**

Reports of all type test conducted as per relevant IS/IEC standards in respect of various bought out items including test reports for degree of protection for FEC /control box / signal box shall be submitted by the supplier.

The supplier shall demonstrate the functional test associated with the following:

- Fire Extinguishing Cubicle, Control Box.
- Fire Detector.
- Transformer Conservator Isolation Valve

The performance test of the complete system shall be carried out after erection of the system with transformer at site.

**10.0.0 DOCUMENTS TO BE SUBMITTED****10.1.0 To be submitted along with offer**

- 10.1.1 General outline of the system.
- 10.1.2 Detailed write-up on operation of the offered protection system including maintenance and testing aspects / schedules.
- 10.1.3 Technical Data particulars (GTP), the format of which is attached in Annexure A of the specification
- 10.1.4 Data regarding previous supplies, date of commissioning, performance feedback etc.
- 10.1.5 Document related to Type test / proof of design as required by statutory body / electrical inspector

**10.2.0 To be submitted after award of contract:**

Detailed dimensional layout drawing of the system with complete bill of materials, clearances from ground and other live points, details of detectors, equipment layout drawings, detailed drawings pertaining to signal box, control box, FEC equipment, wiring and schemes, 4 sets of testing, commissioning, Operation and Maintenance manual along with soft copies (in CDs) shall be submitted by the supplier.

**11.0.0 PACKING, SHIPPING, HANDLING & SITE SUPPORT**

<b>11.1.0</b>	Packing Protection	The packing shall be fit to withstand rough handling during transit and storage at destination. The test set should be properly protected against corrosion, dampness & damage.
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**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

11.2.0	Packing for accessories and spares	Robust non-returnable packing case with all the above protection & identification Label. The bidder should get the packing list approved before dispatching the material.
11.3.0	Packing Identification Label	On each packing case, following details are required:
11.3.1	Individual serial number	
11.3.2	Purchaser's name	
11.3.3	PO number (along with SAP item code, if any) & date	
11.3.4	Equipment Tag no. (if any)	
11.3.5	Destination	
11.3.6	Manufacturer / Supplier's name	
11.3.7	Address of Manufacturer / Supplier / it's agent	
11.3.8	Description	
11.3.9	Country of origin	
11.3.10	Month & year of Manufacturing	
11.3.11	Case measurements	
11.3.12	Gross and net weight	
11.3.13	All necessary slinging and stacking instructions	
11.4.0	Shipping	The seller shall be responsible for all transit damage due to improper packing.
11.5.0	Handling and Storage	Manufacturer instruction shall be followed.
11.6.0	Detail handling & storage instruction sheet / manual to be furnished before commencement of supply.	

**12.0.0 DEVIATIONS**

List of deviations shall be stated in writing with the tender by reference to the Specification clause / GTP/ Drawing. In absence of such a statement, requirements of the Specification shall be assumed to be met without exception by the bidder.

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****ANNEXURE – F – SPECIFICATION FOR SILICAL GEL BREATHER**

This specification is intended to cover the manufacturing, testing at manufacturer's works, supply and delivery of "Silica Gel Breather" to the purchaser.

**1.0 Scope of Supply**

Silica Gel Breather shall be as per REL specification suitable for use in Power Transformer (Main Tank conservator & OLTC conservator) & for Distribution Transformer (Tank Conservator)

**2.0 General**

Silica Gel Breather offered by seller shall be suitable for continuous operation of prevailing climatic conditions as mentioned in Annexure –B

**3.0 Specific Requirement****3.1 Breather**

1.	Body	Aluminium pressure die caste Short Blasted & Powder Coated
2.	Container	Polycarbonate : 143R grade
3.	Oil Cup	Polycarbonate : 143R grade
4.	Gasket	Nitrile cork rubber for main body & oil cup gasket
5.	Silica Gel	Round ball type of size 2-5 mm (deep Blue)
6.	Paint	Powder Coated
7.	Mounting	Threaded for existing Transformers. Flanged type for New Transformers
8.	Hardware	Stainless Steel
9.	Flange Type, Size & hardware	Flange should be of circular shape with diameter of & with hardware of M10 bolts.

3.2 The indicating grade of Silica Gel, which shall be filled in the breather, is hard Blue Round Ball with considerable absorption power of moisture & hence signaling the saturation degree by changing colour ( from Blue to Pink).

3.3 The breather shall have clear visibility of Gel colour & of oil level with dust particles in the oil cup from distance.

3.4 Breather should breathe only from the inlet holes provided for breathing. Air should not enter anywhere from the body of breather.

3.5 Silica Seal shall be applied on gasket for better air tightening.

3.6 Gel removing & refilling method is specially designed to avoid skilled labour requirement at site & consequent air leakages.

3.7 Oil filling indicator on oil cup.

**3.8 Application**

**TECHNICAL SPECIFICATION OF POWER TRANSFORMER**

Transformer Size	Rating	Silica Gel Quantity in KG	
		Main Tank Conservator	OLTC Conservator
Power Transformer	20 & 31.5 MVA	5.0 Kg	1.0 Kg

**3.9 Silica Gel**

Sl. No	Properties	Requirement
1	Particle Size	Round ball type of size 2.5 mm (deep Blue)
2	Bulk Density	570-700 g/l
3	Moisture Adsorption Capacity 1. R.H. = 100% 2. R.H. = 50% 3. R.H. = 40% 4. R.H. = 20%	25 % (min)
4	Appearance	99.5% (min)
5	Friability	99.5% (min)
6	Chlorides percent by mass (max)	0.04%
7	Sulphates percent by mass (max)	0.5%
8	Cobalt percent by mass (max)	0.5%
9	Ammonium Compounds by mass (max)	0.001%
10	Loss on drying	4% (max)
11	pH of Aqueous extract	5-6.5%
12	Loss on Attrition	< 2.5 %

**4.0 Marking**

A Sticker label Indicating manufacturer's Name, Sr. No. Gel capacity etc. shall be provided at suitable place. Container may also marked with the Standard mark.

**5.0 Testing**

Breather container shall be suitably blanked & pressure tested with air at 0.35 Kg/cm for 30 minutes. There shall not be any leakages from gasketed joints. Test certificates from accredited laboratory shall be submitted.

**6.0 Prototype**

Before starting manufacture of the quantity ordered, the successful bidder shall submit a prototype for approval. Unless the prototype is inspected and approved, manufacturing shall not be started. The necessity of submitting prototype shall be ascertained before starting of manufacturing.



**TECHNICAL SPECIFICATION OF POWER TRANSFORMER****7.0 Packing & Keeping Quality**

The material shall be packed in clean, dry & air tight container. The material stored in original air tight containers shall continue to satisfy all the properties of Silica Gel for not less than 6 months from date of packing.

**8.0 Compliance Status / Deviation**

Bidder shall indicate compliance status for every requirement & feature, on the right hand side margin of the specification.

**9.0 Documents Comprising The Bid**

The bidder shall complete the bid proposal sheets inclusive of copy of the specification duly filled in with compliance status, quality & operational manuals, Test certificates etc.

Indicating the material to be supplied, a brief description of the goods, their quantity and prices. In absence of these documents, the offer shall be considered incomplete & may be rejected.



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ANNEXURE – G – MANUFACTURING QUALITY ASSURANCE PLAN

SL NO	COMPONENT & CHARACTERISTICS	CLASS	TYPE OF CHECK	QUALITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
<b>A</b>	<b>RAW Material</b>										
1	<b>Winding Conductor (PICC)</b>										
1.1	Bare Dimensions & Finish of Conductor	Major	Measurement	1 sample per size per lot	MFR. STD / IS 13730 Part 27	MFR. STD / IS 13730 Part 27	Supplier's TC	P	V	R	
1.2	Increase in dimensions due to Paper covering	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.3	Resistivity @ 20°C	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.4	No of Layers	Critical	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.5	Conductor Tensile strength	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.6	Conductor Elongation	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.7	% Overlap of Paper	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.8	Corner Radius	Critical	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9	<b>Kraft Paper Insulation</b>										
1.9.1	Thickness	Major	Measurement	1 sample per size per lot	MFR. STD/ IEC 60554	MFR. STD/ IEC 60554	Supplier's TC	P	V	R	
1.9.2	Apparent Density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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SL NO	COMPONENT & CHARACTERISTICS	CLASS	TYPE OF CHECK	QUALITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.9.3	Air Permeability	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.4	Tensile Index (Longitudinal and Transverse)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.5	Electrical Strength in Air	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.6	Ash Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.7	pH of 5% Aqueous Extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.8	Conductivity of 5% Aqueous Extract	Critical	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.9	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.10	Heat Stability	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.11	Degree of Polymerization	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.12	Elongation (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
1.9.13	Tear index	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>2.0</b>	<b>CRGO Laminations (Watt absorption)</b>										
2.1	Specific Core Loss	Major	Electrical	Random	MFR. STD/IS 3024	MFR. STD/IS 3024	Supplier's TC	P	V	R	
2.2	Surface Insulation resistance	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	

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SL NO	COMPONENT & CHARACTERISTICS	CLASS	TYPE OF CHECK	QUALITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
2.3	Ageing Test	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.4	Stacking Factor	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.5	Waviness	Major	Measurement	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.6	Edge Burr	Major	Visual	-DO-	-DO-	-DO-	-DO-	P	V	R	
2.7	Sample testing for Checking Specific Core loss, accelerated ageing test, Surface insulation resistivity, AC permeability and magnetization, stacking factor, Ductility	Major	Electrical	100%	MFR. STD/IS 3024	MFR. STD/IS 3024	--	--	P	W	Sample will be randomly selected by BSES & will be send for testing at CPRI/ERDA lab.
<b>3.0</b>	<b>Un-impregnated Laminated Wood</b>										
3.1	Thickness	Major	Visual	1 sample size / LOT	MFR.D STD/ IEC 61061	MFR.D STD/IEC 61061	Supplier's TC	P	V	R	
3.2	Density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.3	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.4	Oil Absorption	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.5	Cross breaking strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.6	Compressive Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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SL NO	COMPONENT & CHARACTERISTICS	CLASS	TYPE OF CHECK	QUALITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								S	M	O	
1	2	3	4	5	6	7	8	9			10
3.7	Electric Strength in Oil	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.8	Shrinkage in oil	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
3.9	Tensile Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>4.0</b>	<b>Press Boards (Pre-compressed)</b>										
4.1	Thickness	Major	Measurement	1 sample/Size/LO T	MFR. STD/ IEC 60641	MFR. STD/ IEC 60641	Supplier's TC	P	V	R	
4.2	Tensile Strength (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.3	Shrinkage in Air (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.4	Moisture Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.5	Oil Absorption	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.6	Electrical Strength in Oil and air	Major	Electrical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.7	pH of 5% aqueous extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.8	Conductivity of 5% aqueous extract	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.9	Compressibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.10	Ash Content	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
4.11	Apparent density	Major	Chemical	-DO-	-DO-	-DO-	-DO-	P	V	R	
4.12	Elongation (MD & CMD)	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>5.0</b>	<b>Tank and its accessories</b>										
5.1	Structural steel										
5.1.1	Thickness	Major	Measurement	Random	MFR. STD / IS 2062	MFR. STD / IS 2062	Suppliers TC	P	V	R	
5.1.2	Yield Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.3	Tensile Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.4	Elongation	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
5.1.5	Bend test	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>5.2</b>	<b>Manufacturing of Tank and acc.</b>										
5.2.1	Dimension check	Major	Measurement	100%	MFR. Spec/ DRG	MFR. Spec/ DRG	MFR. Fabrication report	P	W	R	
5.2.2	Joint preparation	Major	Measurement	100%	-DO-	-DO-	-DO-	P	V	R	
5.2.3	Assembly and alignment	Major	Visual and measurement	100%	MFR. Spec/ DRG	MFR. Spec/ DRG	MFR. Fabrication report	P	V	R	
5.2.4	DP Test on Welds on	Major	DP Test	100%	-DO-	-DO-	-DO-	P	W	R	

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								S	M	O		
1	2	3	4	5	6	7	8	9			10	
	Load bearing members eg. Jack Pads											
5.2.5	Pressure test	Major	Mechanical	On One unit	CBIP	CBIP	Test Report	--	P	W	<b>STAGE INSPECTION</b>	
5.2.6	Vacuum test	Major	Mechanical	On One unit	CBIP	CBIP	Test Report	--	P	W	<b>STAGE INSPECTION</b>	
5.2.7	Leakage test											
5.2.7.1	Main Unit	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R		
5.2.7.2	Conservator	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R		
5.2.7.3	Pipes	Major	Mechanical	100%	MFR. STD	MFR. STD	Test report	P	W	R		
5.2.8	Surface preparation	Major	Visual	100%	MFR. STD	MFR. STD	MFR. Fabrication report	P	V	R		
5.2.9	Final Paint Coat (including Primer), Thickness & Shade	Major	Measurement	100%	MFR. STD	MFR. STD	Test report	P	V	R		
5.2.10	Paint Peel off test	Major	Visual	100%	MFR. STD	MFR. STD	Test report	--	P	R		
<b>6.0</b>	<b>Porcelain insulators</b>											
6.1	Make and rating	Critical	Visual	100%	IS 8603/IS 2099/App.Drg.	IS 8603/IS 2099/App.Drg.	Supplier's TC	P	V	R		
6.2	Visual inspection for surface smoothness, any	Critical	Visual	100%	-DO-	-DO-	-DO-	P	V	R		

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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	damage, etc.										
6.3	Important dimension including Creepage distance	Major	Measurement	One sample /size / lot	-DO-	-DO-	-DO-	P	V	R	
6.4	All Routine electrical tests	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>7.0</b>	<b>Magnetic Oil Gauge</b>										
7.1	Make and dimensions	Major	Physical	100%	App.Drg./ Supplier Catalogue	App.Drg./ Supplier Catalogue	Supplier's TC	P	V	R	
7.2	Test for level (eg at 30° Max)	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
7.3	Switch contact test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
7.4	Leakage test	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
7.5	Switch operating and setting	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
7.6	Di-electric test at 2 KV AC between live terminal and body	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>8.</b>	<b>Buchholz relay</b>										
8.1	Make and type	Critical	Visual	100%	App.Drg./ Supplier Catalogue /IS 3637	App.Drg./ Supplier Catalogue /IS 3637	Supplier's TC	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
8.2	Bore size	Major	Measurement	One/size	-DO-	-DO-	-DO-	P	V	R	
8.3	Porosity and element test	Major	Critical	100%	-DO-	-DO-	-DO-	P	V	R	
8.4	Gas volume and surge test	Major	Mechanical	One/Size	-DO-	-DO-	-DO-	P	V	R	
8.5	HV test at 2 KV AC & IR test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
8.6	Continuity for alarm/Trip	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>9.0</b>	<b>Marshalling cum cooler control box</b>										
9.1	Dimensions	Critical	Measurement	100%	MFR. STD / App. DRG.	MFR. STD / App. DRG.	Supplier's TC	P	W	R	
9.2	Make and rating of Components	Major	Visual	100%	-DO-	App Make	Supplier's TC	P	W	R	
9.3	Functional test	Major	Electrical	100%	-DO-	MFR. STD / DRG	Supplier's TC	P	W	R	
9.4	HV test at 2 KV AC for 1 min	Major	Electrical	100%	-DO-	MFR. STD / DRG	Supplier's TC	P	W	R	
9.5	IP 55 test on marshalling cum cooler control box	Major	Environment	--	--	--	Test report	--	--	R	Supplier's Test certificate shall be submitted for review
<b>10.0</b>	<b>Radiator</b>										



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
10.1	Dimension, number of sections	Major	Measurement	100%	MFR. DRG	VTD DRG	Supplier's TC	P	V	R	
10.2	Leakage Test with Air	Major	Visual	100%	As per CBIP	As per CBIP	Supplier's TC	P	V	R	
10.3	Paint shade	Major	Visual & Measurement	Random	MFR. Specs /Drg	MFR. Specs /Drg	Supplier's TC	P	V	R	
10.4	Surface Preparation	Major	Measurement	100%	SA 2.5 of ISO 8503/2	SA 2.5 of ISO 8503/2	Supplier's TC	P	V	R	
<b>11</b>	<b>OLTC and drive mechanism</b>										
11.1	Make, Rating and model	Major	Visual	100%	MFR. Spec/ IS 8468 /IEC 214-1989	MFR. Spec/ IS 8468 /IEC 214-1989	Supplier's TC	P	V	R	
11.2	Copper Contact surface finish	Major	Visual	100%	IS 8468	IS 8468	Supplier's TC	P	V	R	
11.3	Contact Resistance test	Major	Visual	100%	Supplier's STD	Supplier's STD	Supplier's TC	P	V	R	
11.4	Electrical Routine test	Major	Electrical	100%	IS 8468/ IEC 214	IS 8468/ IEC 214	Supplier's TC	P	V	R	
11.5	Mechanical test on diverter switch including pressure test	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
11.6	HV test for Auxiliary	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	circuit										
11.7	Mechanical test on Tap selector switch with motor drive	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	
11.8	Pressure test for Oil Compartment	Major	Mechanical test	100%	-DO-	-DO-	-DO-	P	V	R	
<b>12.0</b>	<b>Transformer Oil</b>	Major	Testing	One Sample from each lot	Annexure D of BSES spec.	Annexure D of BSES spec.	STC	P	V	R	One sample of oil shall be drawn from <b>each lot of Transformer</b> offered for final inspection by BSES representative and same shall be tested at CPRI/ERDA lab as per relevant std.
<b>13.0</b>	<b>OTI / WTI</b>										
13.1	Make and Model	Critical	Visual	100%	MFR. STD/App. Drg.	MFR. STD/App. Drg.	Suppliers TC	P	P	R	
13.2	Calibration	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	
13.3	Check for alarm & trip	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
	signal operation against set value										
13.4	HV test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
13.5	Switch Setting	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
<b>14.0</b>	<b>Bushing Metal parts</b>										
14.1	Dimension Checks	Major	Mechanical	100%	MFR. STD /IS 3347	MFR. STD /IS 3347	Supplier's TC	P	V	R	
14.2	Surface Finish	Major	Visual	100%	-DO-	-DO-	-DO-	P	V	R	
<b>15.0</b>	<b>Current Transformers</b>										
15.1	Dimensions, make	Major	Measurement	100%	MFR. STD /App. DRG. / IS 2705	MFR. STD /App. DRG. / IS 2705	Supplier's TC	P	P	R	
15.2	Rating and terminal marking	Major	Physical	100%	MFR. APPD. DRG	MFR. APPD. DRG	Supplier's TC	P	P	R	
15.3	Measurement of ratio and phase angle error	Major	Electrical	100%	IS 2705	IS 2705	Supplier's TC	P	V	R	
15.4	High Voltage test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
15.5	Inter-Turn insulation test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
15.6	Knee Point Voltage	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	Only for CI-PS CT
15.7	Excitation Current	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	Only for CI-PS



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
											CT
15.8	Secondary winding resistance	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	Only for CI-PS CT
15.9	Polarity	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>16.0</b>	<b>Valves/ Butterfly valves</b>										
16.1	Make & operation	Critical	Visual	100%	APP.drg./MFR. STD	APP.drg./MFR. STD	Supplier's TC	P	P	R	
16.2	Leakage test for body	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
16.3	Leakage test for top spindle	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
16.4	Mounting dimensions	Major	Measurement	100%	-DO-	-DO-	-DO-	P	P	R	
16.5	Material of Body & Seat	Major	Chemical & measurement	1 sample per lot	-DO-	-DO-	-DO-	P	V	R	
<b>17.0</b>	<b>Air Cell</b>										
17.1	Make	Critical	Visual	100%	MFR. STD/App. drg.	MFR. STD/App. drg.	Supplier's TC	P	V	R	
17.2	Dimensional check	Major	Measurement	100%	-DO-	-DO-	-DO-	P	V	R	
17.3	Pressure test for 24 hrs. for leakage	Major	Mechanical	100%	-DO-	No Visible Damage	-DO-	P	V	R	
17.4	Inflation and deflation test (10 times)	Critical	Mechanical	100%	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
<b>18.0</b>	<b>Pressure relief Valve</b>										
18.1	Make	Critical	Visual	100%	MFR. STD/ App. Drg.	MFR. STD/ App. Drg.	-DO-	P	P	R	
18.2	Operating pressure	Major	Mechanical	100%	-DO-	-DO-	-DO-	P	P	R	
18.3	Switch Contact test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	P	R	
18.4	Mounting dimensions	Major	Measurement	100%	-DO-	-DO-	-DO-	P	V	R	
18.5	HV test between body & terminal	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>19.0</b>	<b>Fan Motor &amp; Cooler Fan</b>										
19.1	Verification of Make & rating	Major	Physical	100%	MFR. STD/App. DRG.	MFR. STD/App. DRG.	Supplier's TC	P	V	R	
19.2	Input current power speed	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
19.3	HV test at 2.0 KV	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
19.4	Insulation resistance test	Major	Electrical	100%	-DO-	-DO-	-DO-	P	V	R	
<b>20.0</b>	<b>Gasket</b>										
20.1	Appearance & Finish	Major	Mechanical	1 sample per size per lot	IS 4253-II, 1980	IS 4253-II, 1980	Supplier's TC	P	V	R	
20.2	Hardness, IRHD	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
20.3	Tensile Strength	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
20.4	Compressibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
20.5	Compression set	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
20.6	Flexibility	Major	Mechanical	-DO-	-DO-	-DO-	-DO-	P	V	R	
<b>21.0</b>	<b>Silica gel Breather</b>										
21.1	Type / model	Major	Visual	100%	MFR. STD /DRG	MFR. STD /DRG	Supplier's TC	P	V	R	
21.2	Color of Gel	Major	Visual	100%	-DO-	-DO-	-DO-	P	V	R	
<b>B</b>	<b>In Process</b>										
<b>1</b>	<b>Winding</b>										
1.1	Check for Visual, physical and dimensional Parameters and no. of parallel conductors.										
1.1.1	Measurement of axial height, OD & ID& current density calculation.	Major	Measurement	100%	MFR. Data/Drg	MFR. Data/Drg	QC report	--	P	W	
1.1.2	Copper Conductor size (Bare & covered)	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
1.1.3	No. of Turns / Disc	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	R	
1.2	Winding height	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	



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								S	M	O	
1	2	3	4	5	6	7	8	9			10
1.3	Visual inspection of Brazed joints as applicable	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
1.4	Tap Leads termination in case of tap winding	Major	Visual	100%	-DO-	-DO-	-DO-	--	P	R	
1.5	Current density calculation	--	--	--	--	--	--	--	P	W	
<b>2.0</b>	<b>Core Assembly</b>										
2.1	Visual & Key Dimensional check										
2.1.1	Diagonal distance	Major	Measurement	100%	MFR.Drg	MFR.Drg	QC report	--	P	W	
2.1.2	Window centre distance	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.1.3	Window height	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.2	Stack Thickness	Major	Measurement	100%	-DO-	-DO-	-DO-	--	P	W	
2.3	High Voltage test at 2 KV AC for 1 min between core & core clamp, Yoke bolt	Major	Electrical	100%	-DO-	-DO-	-DO-	--	P	W	
2.4	Pre-Core loss measurement	Major	Electrical	100%	-DO-	-DO-	-DO-	--	P	W	
<b>3.0</b>	<b>Core-Coil Assembly</b>										
3.1	Top & Bottom insulation	Major	Visual	100%	MFR.Data	MFR.Data	QC report	--	P	R	