

## **Tender Notification for**

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

**NIT NO CMC/BR/20-21/SV/RS/KG/903 DT 24.02.2021**

**Due Date for Submission: 16.03.2021 1530HRS**

**BSES RAJDHANI POWER LTD (BRPL)**

Corporate Identification Number: **U74899DL2001PLC111527**

Telephone Number: +91 11 3009 9999

Fax Number: +91 11 2641 9833

Website: [www.bsesdelhi.com](http://www.bsesdelhi.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 Phase-2 of 66/11 kV AIS Grid substation on Single point responsibility basis at Mitraon	13 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 Phase-2 of 66/11 kV AIS Grid substation on Single point responsibility basis at Mitraon NIT NO CMC/BR/20-21/SV/RS/KG/903"

- 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 16/03/2021 1530 HRS at the address given at 3.01 below. Part A of the Bid shall be opened on 16/03/2021 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 13,00,000/-** 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.
- (iv) Technical offer contains any prices
- (v) 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	26.02.2021
2	Pre-Bid meeting	10.03.2021 1430 HRS
3	Last date of Queries, if any	11.03.2021
4	Last date of receipt of bid documents	16.03.2021 1530HRS
5	Date & time of opening of tender – Part A	16.03.2021 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 post/courier to following address. The same shall not be communicated through email/phone

	<b>Technical</b>	<b>Commercial</b>
<b>Contact Person</b>	Mr. Sheshadri Krishnapura(HOD-TSG)	Mr. Robin Sebastian (Head C&M)
<b>Address</b>	BSES Rajdhani Power Ltd , 2 <sup>nd</sup> Floor, B Block, BSES Bhawan, Nehru Place, New Delhi 110019	BSES Rajdhani Power Ltd , 1 <sup>st</sup> Floor, C Block, BSES Bhawan, Nehru Place, New Delhi 110019
<b>Email</b>	<a href="mailto:sheshadri.krishnapura@relianceada.com">sheshadri.krishnapura@relianceada.com</a> <a href="mailto:abhinav.r.srivastava@relianceada.com">abhinav.r.srivastava@relianceada.com</a>	<a href="mailto:robin.sebastian@relianceada.com">robin.sebastian@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 of Phase-2 of 66/11 kV AIS Grid substation on Single point responsibility basis at Mitraon.

### **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
- Grand Summary of the Quoted Price – Section VIII



Vendor Code of Conduct - Section IX  
Scope Demarcation and Route Map – Annexure II  
Technical Specifications - Annexure III

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) 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-Authority 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

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

5 months : Civil Construction at Site (by Consumer) and Electrical equipment Manufacturing

3 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 and Earth Tester and Sheath Integrity test kit with Calibration Certificates for testing the cables. Sheath integrity test will in scope bidder before charging of cable(for 66 kV Cable only)
- 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. Unpriced 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
- 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. However, any statutory fees shall be borne by BRPL on production of documentary evidence.
- 1.21. Taking over 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:
- a) The written acceptance of material by the inspector at suppliers works to ship the materials.
  - b) Acceptance of material at Purchaser site stores after its receipt and due inspection/ testing and release of material acceptance voucher.
  - c) 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:

1. Any amendments to Contract
2. Commercial Terms & Conditions of the Contract
3. Clarifications/addendum/corrigendum to Tender
4. 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 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:
- a) Contractor fails to complete execution of works within the approved schedule of works, terms and conditions
  - b) In case the contractor commits any Act of Insolvency, or adjudged insolvent
  - c) Has abandoned the contract
  - d) Has failed to commence work or has suspended the progress of works
  - e) 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. 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. 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**

Sl no	Description	Qty	UOM	Basic (Rs)	Freight (Rs)	GST (Rs)	Unit Lande d (Rs)	Total Lande d Cost (Rs)
1	NIFPS with all accessories suitable for 16/20 MVA Power transformer	1	Nos					
2	11KV Nuetral CT (2000/1-1)	1	Nos					
3	66kV Control Relay Panel							
3a	66kV Control Relay Panel Line feeder	4	Nos					
3b	66kV Control Relay Panel Transformer feeder	2	Nos					
3c	66kV Control Relay Panel Buscoupler feeder	1	Nos					
4	Li-ion Battery Bank 220V	1	Nos					
5	Battery charger with DCDB	1	Nos					
6	ACDB	1	Nos					
7	66kV single phase gapless metal oxide surge arrestor with support structure	15	Nos					
8	66 kV Cable Mounting Structure	6	Nos					
9	11kV VCB switchgear with numerical protective relays(as per SLD)							
9a	11kV VCB switchgear with numerical protective relays(as per tender SLD/Spec)- Incoming	2	Nos					
9b	11kV VCB switchgear with numerical protective relays(as per tender SLD/Spec)- outgoing	10	Nos					
9c	11kV VCB switchgear with numerical protective relays(as per tender SLD/Spec)- Buscoupler	1	Nos					
9d	11kV VCB switchgear Bus PT inside the bus riser with numerical protective relays(as per tender SLD/Spec)	1	Nos					
9e	11kV VCB switchgear with numerical protective relays(as per tender SLD/Spec)- Capacitor (3.6 MVAR)	2	Nos					
10	High mast lighting 16M high including lighting fixtures	3	Nos					
11	Outdoor LED Lighting including street lighting with poles	10	Nos					
12	Line current differential relay for remote location	4	Nos					
13	66kV 3 Pole SF6 cicuit Breaker along with support structures	7	Nos					
14	66kV Current Transformer 2000-1600/1-1	3	Nos					
15	66kV Current Transformer 1600-800/1-1-1-1	12	Nos					
16	66kV Current Transformer 400-200/1-1-1-1	6	Nos					
17	66kV Potential Transformer	6	Nos					

18	66kV CVT	9	Nos					
19	Horizontally rotating double break motorized isolators with one earth switch	14	Nos					
20	Horizontally rotating double break motorized isolator with 2 earth switch	2	Nos					
21	Horizontally rotating double break motorized isolator without earth switch	7	Nos					
22	Bay Marshaling Kiosk	7	Nos					
23	66kV Monopoles with all fittings and accessories	3	Nos					
24	11kV APFC 2 Stage, 3.6 MVAR capacitor bank with motorized isolator	2	Sets					
25	SCADA RTU	1	Set					
26	Grounding and earthing of entire substation including earthing of yard fence and capacitor bank fence	1	Lot					
27	Fire Suppression system for 11 kv system	1	Set					
28	Video Surveillance system (CCTV)	1	Set					
29	Indoor LED lighting system including emergency lighting	1	Lot					
30	Exhaust ventilation for complete substation building including Air conditioning	1	Lot					
31	Fire detection and alarm system for control room building	1	Lot					
32	Building and outdoor lightning protection system	1	Lot					
33	LT power cable and Control cables including glands	1	Lot					
34	11kV Power cable termination kits along with Glands	1	Lot					
35	Spacers, clamps and connectors with 10% spare each	1	Lot					
36	Cable trays	1	Lot					
37	Tools -tackles and measurement instruments suitable for testing and commissioning	1	Lot					
38	Cabling between equipments and RTU	1	Lot					
39	Control Cable Terminations and Glands	1	Lot					
40	Fire Extinguisher	1	Lot					
41	Galvanized lattice type switchyard structure tower and Girder	1	Lot					
42	ACSR Zebra conductor for 66KV Bus bar and jumpers	1	Lot					
43	String bus with Quad zebra conductor for bus coupler and jumpering	1	Lot					
44	Double and single suspension string and fitting assembly	1	Lot					
45	Double and single tension string and fitting assembly	1	Lot					
46	66kV Post insulators	1	Lot					
47	Galvanised Support Structure for all equipments including post insulators	1	Lot					
48	Spares ( as Per Spec)	1	Lot					
49	Cable sealing system	1	Lot					
50	IT Devices for grid communication 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 upto 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 Tenderer / 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 Contractor 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, Fire Officer, Horticulture department and handing over to owner after successful testing & Commissioning of 66/11 kV AIS Substation at Mitraon, 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, contractor 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 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 Contractor to the Engineer In Charge for checking the adequacy immediately (within seven days) after award of contract.

The Contractor 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 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 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 contractor to keep the materials safe from sun & rain by providing covered storage space as well as using tarpaulins.

The contractor 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 contractor in event of order.
- b. Penalty clause shall be incorporated in case any of workmen of contractor is found violating safety protocol as per BRPL WO.

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 Contractor 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 Contractor'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 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. 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 10 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 Contractor's risk and costs.

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

After completion of the work, the Contractor 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 Contractor. If any rectification/modification required during this period the Contractor 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 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.

The contractor 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 contractor as certified by Engineer In-Charge. Contractor 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 contractor 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 Contractor, the Contractor shall pay to the Company liquidated damages.

If the Contractor 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 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 & SAFETY CODE:**

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

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.

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 Contractor shall be open to inspection by the Company.

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.

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.

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.

#### **17. 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) Work Contract Tax Registration Number/ 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}

#### **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 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 involve 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.

## **19. 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.

## **20. 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.

## **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:**

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

### **24. 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.

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.

### **25. 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.



**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 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 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 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. 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 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. 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 Contractor.

**32. QUALITY**

Contractor 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 Contractor shall maintain proper records of such tools, tackles, instruments and / or equipment.

**33. 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 VII

### PRICE FORMAT – ERECTION, TESTING & COMMISSIONING

66/11kV Mitraon PH-2							
S.No	Item Description	Qty	UOM	Basic (Rs)	GST (Rs)	Unit Landed (Rs)	Total Landed Cost (Rs)
1	ETC of NIFPS with all accessories suitable for 16/20 MVA Power transformer	1	Nos				
2	ETC of 11KV Neutral CT (2000/1-1)	1	Nos				
3	ETC of 66kV Control Relay Panels	1	Lot				
4	ETC of Station Transformer	1	Nos				
5	ETC of Li-ion Battery Bank 220V	1	Nos				
6	ETC of Battery charger with DCDB	1	Nos				
7	ETC of ACDB	1	Nos				
8	ETC of 66kV single phase gapless metal oxide surge arrester with support structure	15	Nos				
9	Fabrication and installation of 66 kV Cable Mounting Structure	6	Nos				
10	ETC of 11kV VCB switchgears with numerical protective relays(as per SLD)	1	Lot				
11	ETC of High mast lighting 16M high including lighting fixtures	3	Nos				
12	ETC of Outdoor LED Lighting including street lighting with poles	10	Nos				
13	ETC of Line current differential relay for remote location	4	Nos				
14	ETC of 66kV 3 Pole SF6 circuit Breaker along with support structures	7	Nos				
15	ETC of 66kV Current Transformer of various ratings	1	Lot				
16	ETC of 66kV Potential Transformer	6	Nos				
17	ETC of 66kV CVT	9	Nos				
18	ETC of Horizontally Rotating double break motorized isolators of various type	1	Lot				
19	ETC of Bay Marshaling Kiosk	7	Nos				
20	ETC of 66kV Monopoles with all fittings and accessories	3	Nos				
21	ETC of 11kV APFC 1 Stage, 7.2 MVAR capacitor bank with motorized isolator	1	Sets				
22	ETC of 11kV APFC 2 Stage, 3.6 MVAR capacitor bank with motorized isolator	2	Sets				
23	ETC of SCADA RTU	1	Sets				

24	Installation of Grounding and earthing of entire substation including earthing of yard fence and capacitor bank fence	1	Lot				
25	Installation of Fire Suppression system for 11 kv system	1	Sets				
26	ITC of Video Surveillance system (CCTV)	1	Sets				
27	Installation of Indoor LED lighting system including emergency lighting	1	Lot				
28	Installation of Exhaust ventilation for complete substation building including Air conditioning	1	Lot				
29	ETC of Fire detection and alarm system for control room building	1	Lot				
30	Installation of Building and outdoor lightning protection system	1	Lot				
31	Laying, testing, termination of LT power cable and Control cables including glands	1	Lot				
32	ITC of 11kV Power cable termination kits along with Glands	1	Lot				
33	Installation of Cable trays	1	Lot				
34	Laying, testing, termination of Cabling between equipments and RTU	1	Lot				
35	ITC of Control Cable Terminations and Glands	1	Lot				
36	Installation of Fire Extinguisher	1	Lot				
37	Fabrication and installation of Galvanized lattice type switchyard structure tower and Girder	1	Lot				
38	Stringing of main double bus bar and jack bus using ACSR Zebra including installation of hardware fittings, Spacers, clamps and connectors	1	Lot				
39	ETC of 66kV Post insulators	1	Lot				
40	Fabrication and installation of Galvanized Support Structure for all equipments including post insulators	1	Lot				
41	Installation of Cable sealing system	1	Lot				
42	ETC of IT Devices for grid communication	1	Lot				
43	Dismantling of circuit breaker with mechanism box & CT i/c.determination of control cable,removal of jumpering & draining of oil and shifting upto the transport place. 66KV MOCB/OCB/SF6	1	Nos				
44	Dismantling of 11 kV Indoor switchgear, Incoming panel	1	Nos				
45	Dismantling of 11 kV, Indoor switchgear, Outgoing panel	8	Nos				
46	Dismantling of 11 kV, Indoor switchgear, Capacitor panel	1	Nos				
47	Dismantling of 11 kV, Indoor switchgear, Station transformer panel	1	Nos				
48	Dismantling of 11 kV, Indoor switchgear, Bus PT panel	1	Nos				

49	Dismantling of AC Distribution board	1	Nos				
50	Dismantling of DC Battery Bank 220 V, 100 AH/150 AH complete with accessories I.e. wooden structure, battery cells	1	Nos				
51	Dismantling of 50/220 V DC distribution Board	1	Nos				
52	Dismantling of 50/220 V Float cum boost battery charger	1	Nos				
53	Dismantling of Bay Terminal/Marshalling Kiosk	1	Nos				
54	Dismantling of 66 KV Control Relay Panel	1	Sets				
55	Dismantling of 11 kV capacitor bank	1	Sets				
56	Dismantling of the following from kiosk/ indoor type. S/stn. Including their safe removal and stacking at tent site including loading and unloading (the work also includes the removal of all the electric/earth connections)315/400 KVA Transformer.	1	EA				
57	Dismantling/ Reclaiming and de-termination of HV cables from dugged trench and re-rolling the cable on the drum or in the shape of coil and transportation to store/ tent site for 11 kV, 3CX300 sqmm XLPE cable	70	M				
58	Dismantling/ Reclaiming and de-termination of PVC insulated, armoured control and auxiliary power cables from dugged trench and re-rolling the cable on the drum or in the shape of coil for 12CX2.5 sqmm, Cu	1300	M				
59	Dismantling/ Reclaiming and de-termination of PVC insulated, armoured control and auxiliary power cables from dugged trench and re-rolling the cable on the drum or in the shape of coil for 7CX2.5 sqmm, Cu	600	M				
60	Dismantling of cable structure and dismounting of 6Nos 66 kV1X1000 cables end boxes from its structure after cutting the channel frame and dismantling cleats & post insulators	1	EA				
61	Resetting, mounting and connection of cable structure and dismounting of 9Nos 1X1000MM cables end boxes from its structure and installation of cleats & post insulators	1	EA				
62	Dismantling of MS as well as galvanised structure for different equipment like isolator, C.T.'s, P.T.'s, CVT, LA's, ISO etc, cable supporting structure, 33kV/66 kV GI gantry and tower structure including consumables, welding electrode & hacksaw blades etc.	2	MT				
63	Inspection by BRPL Officials (As per Spec)	1	Lot				
64	Training of BRPL officials (As Per spec)	1	Lot				

**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 Tenderer / 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 MITRAON, New Delhi, including all statutory clearances & certification from State Electrical Inspector, Municipal corporation department, Fire officer, Horticulture department, 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 and 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, 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 & 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 upto 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, within 10 days 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) for 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 confirm to IS 383, reinforcement for cold twisted bars shall confirm to IS 1786, the bricks for brick work shall correspond to IS 1077, Structural steel shall confirm 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 Contractor 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. SECRECY 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 Tenderers (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.

- d) Has abandoned or repudiated the Contract
- e) 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.
- f) 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.
- g) 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**

<b>SL.N o.</b>	<b>Description</b>	<b>Qty</b>	<b>Unit</b>	<b>Basic (Rs)</b>	<b>GST (Rs)</b>	<b>Unit Landed (Rs)</b>	<b>Total Landed Cost (Rs)</b>
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	Provision of additional gate (3 m width & 2.1 m height) in existing boundary wall as per approved design & specification.	1.00	LS				
3	Substation building, with cable cellar if required during detailed engineering 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 & brick wall of parapet- 15% iv) Internal/ external finishing and terracing - 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				
4	All Outdoor Control & Power cable trenches with trench covers (RCC slab or RCC cover), supporting hangers, etc as per specification and system requirement.	1.00	Lot				
5	Power transformer foundations & P/F MS grating over oil collection chamber around transformer foundation as per specification.	2.00	Nos				

6	A) Fire wall between transformers/ as per layout/ as per IS/IEC/TAC.	1.00	Nos				
	B) Oil collection pit, BOT and pipe connection for Burnt Oil tank as per IS/IE/TAC.	1.00	Lot				
7	RCC/ Cement concrete/ Paver block road inside substation as per layout and specification.	1.00	LS				
8	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				
9	Underground water tank with electrical (Booster) pump of sufficient capacity and one outlet and hose, etc.	1.00	Set				
10	Rain water drainage arrangement within and outside switchyard, Rain water harvesting system (as per approved CGWB specification) & arrangement for drinking water, sanitary system , etc.	1.00	Lot				
11	Equipment foundation, Gantry/ tower foundation, Capacitor bank foundation, Auxiliary/ local transformer foundation, foundation of lighting poles, BPI foundation, etc. and construction of brick steps with cement plaster for smooth operation of circuit breakers, etc.	1.00	Lot				
12	Fencing with gate of Switchyard, Capacitor bank, Auxiliary/local transformer, etc as per IE/CBIP.	1.00	Lot				
13	Foundation & Oil tank for NIFPS equipment.	1.00	LS				
14	Supply of good earth (or other approved filling material) including filling in trenches, plinth, 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				

15	Dismantling/ demolishing of Y angle and concertina coil over existing boundary wall, existing steel kiosk, steel structures, IRC frames, RCC foundations, equipment foundation, trenches, road, etc as per requirement of final approved layout. The scope also covers dismantling of yard, yard flooring, collecting stones of transformer yard, cutting of reinforced bars of RCC structures, trench covers, etc. After demolishing the contractor shall remove all Serviceable/Unserviceable materials, malba, etc. to level the site. The contractor shall give the credit on account of all serviceable scrap material arising out of demolition and taken away from site.	1.00	LS				
16	Providing/ fixing of IRC weld mesh panels of height 1.5 m on existing entire length of boundary wall with all around angle frame & MS flat beading for fixing the mesh and the mesh panel frame shall be fixed to intermediate MS channel (box) post. Providing Y-shape angle over intermediate MS channel post and concertina coil 600 mm dia over the panels. Fencing shall be designed for the most critical loading combination taking care of wind force, stability, tension on wires, etc and shall be approved by BRPL.	1.00	LS				
-	<b>Total</b>						
-	-						
<b>Note:</b>	<b>For detail description, kindly refer Technical Specification for Civil Work</b>						

**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 Phase-2 of 66/11 kV AIS Grid substation on Single point responsibility basis at Mitraon				
<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 & Signature .....

Designation: .....

Common Seal:.....

**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 & 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 its 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**

Sl 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 \_\_\_\_\_)

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 AIS GRID SUBSTATION**

**AT MITRAON PHASE-2, NEW DELHI**

**ON TURNKEY BASIS**

**(SPEC NO. BRPL-EHV-TS- MTRAON PHASE-2)**

Prepared by	Seema Shekhawat		Rev: 0
Reviewed by	Abhinav Srivastava		Date: 04.02.2021
Approved by	Sheshadri Krishnapura		

**Technical Specification for 66/11kV Mitraon Phase-2 AIS Grid Substation at New Delhi**

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# **TECHNICAL SPECIFICATION FOR GENERAL DESIGN CRITERIA**

Prepared by	Seema Shekhawat /Javed		Rev: 0
Reviewed by	Abhinav Srivastava		Date: 02th Feb 2021
Approved by	Sheshadri Krishnapura		

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

### **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 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, DCDB etc. The suggestive and existing Layout Plan/Single Line diagram of the substation is enclosed herewith.

This specification shall be read and constructed 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 'Vendor', 'Bidder' and 'Contractor' has been used interchangeably.

It may please be noted that in the proposed plot there is an existing substation. The existing substation consisting one line bay and one trafo bay having following equipments:

- a. One Power transformer
- b. One kiosk consisting of followings:
  - i. One battery bank
  - ii. One battery charger
  - iii. One capacitor bank
  - iv. One ACDB
  - v. 11KV Panels
- c. CTs
- d. PTs
- e. CVTs
- f. 11kV Panel
- g. 66kV outdoor breaker etc.

For details refer our existing substation SLD and Layout. 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 testing, inspection, packing, dispatch, loading, unloading and storage at site, transit/storage and construction



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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, Horticulture department etc. and handing over to the Owner after satisfactory commissioning of complete 66/11 KV substation of BSES Rajdhani Power Ltd. at Mitraon Ph-2, 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 and Indian Electricity Act.

The scope of supply broadly includes the following:

### **2.1 Major Equipments:**

- 11KV Auto-Switched Capacitor Bank (APFC) Outdoor Type –and 3.6 MVAR Two (2) Sets.
- NIFPS with all necessary fittings and accessories- 1 Sets
- 66KV Control and Relay Panel – 7 Nos.
- SCADA RTU-1Set
- 3Pole SF6, Circuit breaker with support structure – 7 Nos.
- 66KV single phase gapless metal oxide surge arrester – 5 Sets (3 Nos. per set)
- 66KV Current Transformer – 21 Nos.
- 66KV Potential Transformer – 6 Nos.
- 66KV CVT--9 Nos.
- Horizontally rotating double break motorized isolators with one earth switch – 14 Nos.
- Horizontally rotating double break motorized isolators with two-earth switch – 2 Nos.
- Horizontally rotating double break motorized isolators without earth switch – 7 Nos.
- Outdoor Bay Marshalling Kiosk – 7 Nos.
- High mast lights 16 M high – 3 Nos.
- 66KV Monopole- 3Nos.
- ACDB-1No.

### **2.2 Item as System**

- 11KV VCB Switchgear with Numerical protection relays (refer SLD).
- Grounding and earthing of entire substation including all the fences such as Power Transformer Fencing, Aux. transformer fencing and capacitor bank fencing.
- 220V Battery bank and one battery charger with DCDB
- Outdoor illumination including street lighting with Poles.
- Indoor illumination including emergency lighting (DC lighting incase of black out)
- Exhaust and Ventilation for complete substation building including air conditioning
- Fire detection and alarm system including its SCADA integration.
- Direct stroke lightning protection by shielding spikes.
- Building and outdoor lightning protection system.
- Fire suppression system including its SCADA integration
- Video Surveillance system (CCTV)

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

- Cable sealing system
- Fire Extinguishers
- 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-L for Details).

### **2.3 Items as Lot**

- LT Power & Control cables supply and termination and Glands.
- Supply and providing 11KV Power cable termination kits and Glands.
- Cable trays.
- Galvanized lattice type switchyard equipment support structure including foundation bolts.
- Galvanized lattice type switchyard Towers including foundation bolts.
- Galvanized lattice type switchyard Beams for conductor support.
- Double and single suspension / tension string assembly.
- Spacers, Clamps and connectors.
- ACSR ZEBRA Conductor.
- Tools -tackles and measurement instruments suitable for testing and commissioning
- Cabling between equipments and RTU.
- Supply Erection testing and commissioning of Line differential protection Relay at remote end.
- Post insulators and Disc Insulators
- Insulating mat for Control & Switchgear room building

### **2.4 Civil Works**

- Control Room Building shall be designed for G+1 floor.
- Dismantling/ demolishing of existing steel kiosk, steel structures, IRC frames, RCC transformer foundation, equipment foundations & brickwork of trenches. The scope also covers dismantling of yard, yard flooring, collecting stones of transformer yard, cutting of reinforced bars of RCC structures, trench covers, etc. After demolishing the contractor shall remove all Serviceable/Unserviceable materials, malba, etc. to level the site. The contractor shall give the credit on account of all serviceable scrap material arising out of demolition and taken away from site.
- Provision of additional gate in existing boundary wall as per approved design & specification.
- Foundation of towers, equipments including respective structures.
- Site preparation, filling up to formation level, removal of trees if any and site cleanliness
- Power Transformer foundation & grating, oil soak pit, fire wall and burnt oil tank
- Foundation of lighting poles including structure & bay-marshalling panel.
- Capacitor bank foundation, Auxiliary Transformer foundation and fencing for both.
- Anti weed treatment and gravel surfacing of the substation area wherever required.
- Substation fencing and gates.
- Indoor and Outdoor Cable Trenches with cable trays and trench covers for 66KV, 11KV & Control Cables.
- Rain Water Harvesting system for entire substation area.
- Road & rainwater storm drainage system for outdoor switchyard with final connection to Rain Water Harvesting recharge pit.

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

- All civil work required for installation and erection of equipments inside and outside building.
- Landscaping.
- NIFPS system & underground water tank
- Supply of material required for above works.

Please note that raising the height of existing boundary wall by 1.5 Meters using IRC Weld mesh panel shall also be in the scope of work.

### **2.5 Dismantling of already installed various equipments:**

Dismantling of following equipment shall be in the scope of work:

1. 11KV Panel board-12Nos Panel(Schneider make)
2. CRP for Trf. -1No.(Popular make)
3. APFC 7.2MVAR -1No
4. ACDB-1No
5. Battery charger with DCDB-1No
6. SCADA RTU-1No
7. Battery bank-.1Set
8. Air Conditioners- as per site requirement
9. IT Tower
10. Station Transformer-1No
11. Cable and Terminations

Dismantled material shall be reinstalled or shall be transported to BRPL Stores as per direction of project in charge. All transportation and reinstallation shall be covered under scope of work.

### **2.6. 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.

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- Lot : Operation & Maintenance Manuals and As-built drawings. (Six sets hard copy & two sets soft copy)
- Lot : Documentation required by State Electrical Inspector or by other statutory body for statutory approval/certification of the Substation installation. (as required)
- Lot : Temporary sheds for storage of equipment, tools & tackles, construction offices etc. 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 specifically listed above but covers all items required for the completion of a safe and fully functional Substation.

### 2.7 Tools and Spares

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

## 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 LOI. The broad completion schedule is attached here under for reference. The detail 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 detail 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 LOI:

Sl.No.	Description of Work	Time Line	Responsibility
1	Zero Date (Letter of Award)		BRPL
2	Submission of Drawings/Documents/calculations for Engineering Approval	30 days from Zero Date	Vendor
3	Engineering Approval	60 days from Zero Date	BRPL
4	Civil Works	130 days from Zero Date	Vendor
5	Procurement/Supplies	220 days from Zero Date	Vendor
6	Equipment Erection	220 days from Zero Date	Vendor
7	Commissioning of 66kV Monopoles	225 days from Zero Date	Vendor
8	Commissioning of 1 <sup>st</sup> Power Transformer	240 days from Zero Date	Vendor
9	Commissioning of 2nd Power Transformer	270 days from Zero Date	Vendor
10	Testing & Commissioning of entire substation	300days from Zero Date	Vendor

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

### **4.0 ELECTRICAL POWER & WATER FOR CONSTRUCTION**

Electrical Power Supply and Water for construction purpose shall be arranged by vendor.

### **5.0 SUPPLY AND WORKS BY OWNER**

**SUPPLIES AS FREE ISSUE ITEMS:** The following items shall be supplied free of cost to vendor:

1. 2Nos 16/20MVA Power Transformers
2. 1No 11kV panel Board
3. 1No CRP
4. 1No Cap Bank
5. ACSR Goat Conductor
6. 11 kV 1x1000 sq. mm. XLPE Cables
7. 11 kV 3x300 sq. mm. XLPE Cables
8. 66kV 3Cx300 sq. mm XLPE Cables (If required)
9. 66 kV 1x1000 sq.mm. XLPE Cables (if required)

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

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

1. Soil Investigation and Soil resistivity test.
2. Laying of 11 kV outgoing cables circuits from 11 kV outgoing panels to load centre including its termination.

However, the trenches and cable trays for outgoing cables shall be in the scope of vendor.

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

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.

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 paid to electrical inspector / statutory bodies shall be borne by the bidder.

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### 7.0 COORDINATION WITH OTHER CONTRACTOR & PURCHASER & OWNER'S SYSTEM

The contractor shall be fully responsible for carrying out all the co-ordination work required with the contractors as well as with owners system for execution and completion of his work.

### 8.0 TERMINAL POINTS OF VENDOR'S SCOPE

- 8.1 Up to Line take off point and including provision for Cable termination at outgoing bays.
- 8.2 Outdoor Cable Trenches : Upto the boundary wall of substation
- 8.3 Water supply and drainage at suitable point near the substation boundary wall at location to be decided later.

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

#### 9.1 Introduction

BRPL is setting up 66/11KV AIS Grid substation at Mitraon PH-2 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	LILO of 220kV NAJAFGARH to JAFFARPUR
Infeed arrangement	O/H Line 66kV Multi ckt Monopole
Infeed Scope	Installation of 66kV Multi ckt monopoles and extension of line upto gantry structure in bidder's scope
Substation Capacity	3x 20MVA
Present status of Land	In possession of BRPL
Previous work done at site(if any)	For details please refer para no 5. of clause no.1

66 kV Infeed to the substation shall be provided as per the table above by Erecting 3 Nos 66KV Multi ckt Monopoles comprising of ACSR Zebra conductor per phase and shall be terminated at 66KV incoming bays of respective substation. The Supply and ETC of 66KV Multi ckt Monopoles will be in the bidder's scope.

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

### **9.2 Substation Capacity**

The substation capacity shall be as per the table in Clause no. 9.1 above. However, provision for 3rd 20 MVA Power Transformer (Civil foundation for equipment structures, Power Transformer Foundation, Cable trenches and 66kV C&R panel etc.) shall be kept in turnkey execution of grid substation, so that the Transformer bay is ready in all respect for installation of 3rd Power Transformer in future.

### **9.3 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.

### **9.4 66/11KV Power Transformer**

The Outdoor Power transformer shall be 16/20MVA, ONAN/ONAF Rating with OLTC and same shall be free issued by Owner. Supply of microprocessor based Transformer monitoring relay (a-eberle relay model no shall be finalized during drawing approval of CRP) and NIFPS with all fittings and accessories for each Power Transformer shall be in Bidder's scope.

### **9.5 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 and. The battery charger shall be installed inside control room building and shall be SCADA compatible.

### **9.6 11kV Capacitor Bank**

Two sets of 3.6MVAR 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, Automatic power factor controller and all necessary equipment for auto switching.

### **9.7 66KV Control & Relay Panel:**

It is intended to provide State-of-Art substation control, protection and metering system and shall be integrated with SCADA system. The protection, metering & control system shall be as per SLD and specification of 66KV CRP.

All the relays/IED communications shall be on IEC 61850/Modbus protocol.

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### 9.8 66KV Monopole:

66KV KV Multi ckt Monopoles with all fittings and accessories shall be provided for the in-feed arrangement of substation.

### 9.9 Substation Building

The substation shall have single storied building with all the equipments installed on ground floor. Design of building shall be such decided that minimum one floor can be added in future. The Cables shall be laid in cable trench with cable trays, inside and outside of the building. Trenches shall be covered with trench cover.

### 9.10 SCADA and Automation

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.

### 9.11 Other Parameters for 66 KV Substation

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

#### 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



## Volume – I Technical Specification | General Design Criteria

### Parameters for Outdoor Switchyard Equipments (66KV)

S. No	Particulars	Data
1	Minimum Creepage	31mm/KV
2	Minimum Clearances	
2.1	Phase to Phase	630 mm
2.2	Phase to Earth	630 mm
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(Main bus and Jack Bus)	Double Bus
5	Bus coupler bay	Quad ZEBRA
6	Shielding Wire	7/8 SWG.

### 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

## 10.0 CODES & STANDARDS

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

## 11.0 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>	<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.

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15	BOQ of Cables.
16	Codification of cable trays and cable tray/cable tag marking concept.
17	Underground ground mat design Calculation from actual site soil investigation.
18	Drawing of Underground ground mat along with BOQ.
19	Drawing of Indoor equipment grounding details.
20	Outdoor equipment grounding arrangement and details.
21	BOQ of Grounding Materials.
22	Input /Output list of SCADA system.
23	Outdoor Illumination system design Calculation.
24	Indoor Illumination system design Calculation.
25	Drawing of Outdoor Illumination with erection details.
26	Drawing of Indoor Illumination with erection details.
27	Complete BOQ indoor and outdoor illumination system
28	CT/PT sizing/detail calculation of burden, knee point voltage
29	All major equipment sizing calculation
30	Cabling, earthing & lightning concept
31	Power Transformer foundation details, soak pit arrangement, firewall segregation
32	Fire fighting arrangement of Transformers and indoor equipments
33	Relay setting with calculations
34	Sizing Calculation of Main Bus Bar & Jack/Cover Bus Bar
35	As built documentation of the drawing / documents
36	Design and calculations for Multi ckt Monopoles
37	Sag and tension circuit calculation for Monopole lines
38	Line profiling indicating min ground clearances and design validation from IIT Bombay
<b>B. Civil Drawing</b>	
1	Layout Plan For Control Building
2	RCC detail of Control Room Building
3	RCC detail of Cable Trench including trench cover
4	GA & RCC detail of Gantry Tower foundation
5	GA & RCC detail of Transformer foundation & Oil Soak pit
6	GA & RCC detail of Auxiliary Transformer
7	GA & RCC detail of Burnt Oil Tank
8	GA & RCC detail of Lighting poles
9	Structural Detail of Gantry tower
10	Structural & RCC Detail of "LA"
11	Structural & RCC Detail of "Circuit Breaker"
12	Structural & RCC Detail of "CT"
13	Structural & RCC Detail of "PT"
14	Structural & RCC Detail of Pot Head Cable
15	Structural & RCC Detail of "BPI"
16	Structural & RCC Detail of "CVT"
17	Structural& RCC Details of Isolator
18	Overall layout plan indicating landscaping.
19	Detail of Fire wall
20	GA & RCC detail of NIFPS System
21	Detail of Water Supply and Sanitary system
22	GA & RCC detail of Septic Tank
23	Detail of Rainwater Harvesting System (detail of recharge pit)
24	GA & RCC detail of Underground Water Tank

## Volume – I Technical Specification | General Design Criteria

25	GA and detail of fencing of Switchyard, Capacitor Bank & Auxiliary Transformer
26	GA and Section of Road & Storm Water Drain
27	Trench layout for switch yard
28	Sectional Details for Trenches
29	Conduit plan for Control room building.
30	Switch yard layout
31	Foundation design and calculation for Multi circuit Monopoles

### 12.0 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 submission shall be

- Two (03) Sets of approved and released for construction drawings/BOQ/Calculation for Owners reference.
- 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.

### 13.0 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 owner's decision.

Type test has to be carried out at CPRI or NABL accredited lab only, routine and acceptance test and special test 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 or equivalent/NABL accredited Laboratory.

### 14.0 QUALITY PLAN

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

- An outline of the proposed work and programme approval. Plan shall contain sequence
- The structure of the supplier's organization for the contract
- The duties and responsibilities assigned to staff ensuring quality of work for the contract
- Hold and notification points
- Submission of engineering documents required by the specification
- The inspection of materials and component on receipt
- Reference to the supplier's work procedures appropriate to each activity

## Volume – I Technical Specification | General Design Criteria

- VIII. Inspection during fabrication /construction
- IX. 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.

### 15.0 INSPECTION

Cost of all the inspections within India and abroad (including re inspections) including flight Tickets, local conveyance, Boarding and lodging (Minimum 4 Star Hotel for India and Minimum 5 Star for Abroad) shall be in scope of Vendor. The Factory visits will be held at OEM Factory only.

Detailed Breakup of no. of inspectors for each inspection is as under.

S. No	Equipment	No of Inspectors
1	CRP	3
2	RTU	2
3	HT Panels	2
4	For all other equipments	1
5	For all Stage inspections	1

In addition to above one inspector from EPC contractor must be available for inspection along with BRPL executives

### 16.0 TRAINING OF BRPL OFFICIALS

Please refer chapter 38

### 17.0 SUPPLY OF MEDICAL KIT

Provision of First aid boxes shall be compulsory as per Indian Electricity act. First aid boxes shall be provided by vendor as per relevant standard.

### 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 HT Panel and CRP.

### 19.0 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**  
**CIVIL WORK**

Prepared by	Amrita Singh		Rev: 0
Reviewed by			Date: 22 <sup>th</sup> January, 2021
Approved by	Rajinder Rajpal		

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

### **1.0 GENERAL REQUIREMENT**

- 1.1. This chapter includes the technical requirements for 66kV Sub-station at Mitraun 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 to 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 him clarified on any doubts about the specifications, etc. before bidding and the discussions recorded in writing with the Owner in respect to interpretation of any portion of this document.
- 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 purposes only. However, the Contractor shall quote according to the complete requirements.
- 1.4. The Contractor shall take all necessary precautions to protect all the existing equipments, 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 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 &

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

Estimation Work.

### **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. Dismantling/ demolishing of Y angle and concertina coil over existing boundary wall, existing steel kiosk, steel structures, IRC frames, RCC foundations, equipment foundation, trenches, road, etc as per requirement of final approved layout. The scope also covers dismantling of yard, yard flooring, collecting stones of transformer yard, cutting of reinforced bars of RCC structures, trench covers, etc. After demolishing the contractor shall remove all Serviceable/Unserviceable materials, malba, etc. to level the site. The contractor shall give the credit on account of all serviceable scrap material arising out of demolition and taken away from site.
- 3.2.2. 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.
- 3.2.3. The Contractor shall have to provide a gate of approved size and design by dismantling existing boundary wall (as per approved location). Contractor shall have to make good to all the damages to the boundary wall and gate during work execution, if occurs.
- 3.2.4. 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.
- 3.2.5. 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 specifications.
- 3.2.6. 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.
- 3.2.7. Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the Owner.
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- 3.2.8. 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 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 compacting 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 10cm in any direction shall not be placed in embankment adjacent to 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 and as per direction of 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 minimum 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 adequate drainage system. Upon completion of the roads 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



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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.

## **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, filling up to formation level, removal of trees, if any and site cleanliness
- v. Foundation design & drawing of Power Transformer
- vi. Design & drawing of transformer grating, firewall & burnt oil tank
- vii. Foundation design & drawing for lighting pole.
- 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 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 of RCC framed structure of minimum concrete grade M25. The Sub-Station Building shall include rooms as specified below:

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S. No.	Facility
i.	Control Room
ii.	Switchgear Room
iii.	Maintenance Room
iv.	Pantry
v.	Store Room
vi.	Toilet

- 6.1.2. Minimum floor area requirements have been given in tender drawings, which may be increased at the time of detailed engineering to suit project requirements.
- 6.1.3. 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.
- 6.1.4. 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.
- 6.1.5. 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 Control Room building.
- 6.1.6. 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).

### 6.2. 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.
  - 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..
-

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- Using fire retarding materials for walls, ceilings and doors to prevent spreading of fire wherever required.
- Using materials preventing dust accumulation.
- b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.
- c) Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.
- d) Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
- e) The building lighting shall be designed in accordance with the requirements of relevant section.
- f) The building auxiliary services like Air Conditioning, exhaust and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in the Specification for the project.
- g) The building shall have atleast 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.

For consideration of loads on structures IS: 875 (latest revision), the following minimum superimposed live loads shall however be considered for the design.

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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 15KN/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:

- 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.
- Structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.
- 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.
- 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.
- Product information of building components and materials, including walls partitions, flooring, ceiling, roofing, door and windows and building finishes.
- A detailed schedule of building finishes including colour schemes.
- A door & window schedule showing door types and locations, door lock sets, latch sets and other door hardware.
- Copy of all tests/ studies/ investigation carried out by bidder as per scope.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction activity.

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### **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

### **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 340mm upto DPC level in cement mortar 1:6 (1 Cement : 6 Coarse sand) and 230mm above DPC level in cement mortar 1: 4 (1 Cement :4 coarse sand).

### **6.7. Plastering**

All internal walls shall have minimum 12mm/ 15mm thick 1:4 (1 Cement : 4 fine Sand) cement sand plaster. The ceiling shall have 6mm 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 grooves formed) (item no.13.72-DSR 2012) finish over 12mm 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 details of doors and windows of the control room building shall be as per finish schedule Table-I and tender drawing with the relevant IS code. Paints used in the work shall be of best quality specified in CPWD specification.

### **6.10. Partition**

Partition made of powder coated aluminum frame provided with 12.0 mm thick toughened glass shall be supplied and installed at locations shown in tender drawings.

### **6.11. Internal Electrification**

Electrical wiring shall be through heavy duty concealed conduits. All fixtures and wiring shall be of best quality and ISI marked. (Fixtures shall be provided as per provision of energy conservation act). Internal wiring shall include all fittings and fixtures, control panel boards, main switch MCB's, etc.

### **6.12. Plumbing & Sanitation**

- 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.

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- 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) Unplasticised PVC/ Chlorinated Polyvinyl- chloride (CPVC) pipe shall be used for internal & external piping work for potable water supply.
- d) PVC pipes for all sanitary works.
- e) All sanitary/ water supply 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 2012) or water closet (Indian type W.C. pan) Orissa Pattern (580 x 440 mm) (item no. 17.1.1- DSR 2012) with all fittings (both types of WCs shall be provided at alternate locations).
  - ii) Half Stall Urinal (580 x 380 x 350 mm) with all fittings (item no. 17.5.2- DSR-2012).
  - iii) Wash basin (630 x 450 mm) with all fittings (item no. 17.7.1- DSR 2012).
  - iv) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing (item no. 17.31- DSR 2012).
  - 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 near control room instead of toilet block.
  - h) An Eye & face fountain conforming to IS:10592 shall be provided for battery room.
  - i) 1 No stainless steel A ISI 304(18/8) kitchen sink as per IS 13893 with Drain board (510 x 1040 x 225mm bowl depth for pantry shall be provided complete with all fittings (item no. 17.10.1.2-DSR 2012).
  - j) All fittings, fastener, grating shall be chromium plated.
  - k) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the Manufacturer.
  - l) Soil, waste and drain pipes for underground works shall be stoneware for areas not subject to traffic load. Heavy-duty cast iron pipes shall be used otherwise.

## **7.0 STORM WATER DRAINAGE FOR CONTROL ROOM BUILDING**

The building drain shall be provided for the collection of storm water from the roofs. 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.

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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 along road shall be covered with precast perforated RCC covers 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
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%

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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 10M x 10M (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:
- Providing and laying in position 75mm thick base layer of cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 brick aggregate 40mm nominal size).
  - 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 12mm thick all around the bricks with same mortar.
  - 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 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
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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. Cable trench covers shall be 50 mm thick. 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.
- 9.4. 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.
- 9.5. 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.
- 9.6. Trenches shall have proper slope. Necessary sumps be constructed and sump pumps if necessary shall be supplied/ installed. Cable trenches shall not be used as storm water drains.
- 9.7. The top of cable trench shall be such that the surface rain water does not enter the trench.
- 9.8. All metal parts inside the trench shall be connected to the earthing system.
- 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.
- 9.12. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm/15mm thick 1:4 cement sand mortar.
- 9.13. Provision of sump and pump is to be done for disposal of rain water from trench.

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### **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 2.4m/sec and 1.8m/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 30m interval, at connection points and at every change of alignment.
5. Pipe drains shall be connected through manholes at an interval of maximum 30m. Effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.
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 for 3 nos cars & 3 nos two wheeler 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. 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

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pavers manufactured by PLC based automated block/paver making machine having compression and vibration both in sequence using multi cavity precision steel moulds in place of M-30 grade 60 mm thick CC Paver manufactured by vibratory compaction method.

- 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.

### **12.0 TRANSFORMER FOUNDATION, RAIL TRACK/ ROAD CUM RAIL TRACK**

- 12.1. 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.
- 12.2. The space between the transformer foundation pedestals shall be suitably filled with local sand and 75 mm thick PCC of grade 1:3:6 placed over sand filling. The top of PCC shall be upto the formation level. Suitable drainage system between the pedestals shall be provided.
- 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 40 mm to 60 mm which acts as an extinguisher for flaming oil.

### **13.0 TRANSFORMER OIL PIT & BURNT OIL TANK**

- 13.1. The oil recovery system shall be provided for all transformers (containing insulating oil or any flammable or polluting liquid) in order to avoid spread of fire by the oil and for environmental protection.
- 13.2. 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 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.

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- 13.3. Each transformer pit shall be drained towards a sump pit whose role is to recover the infiltrating water and the drained oil from the pit. The sump pit shall have sufficient capacity to receive without overflowing the oil content of large transformers 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 sump pit should be impermeable.
- 13.4. The retaining walls which make up the transformer pit shall be made of fire resistant material such as reinforced cement concrete, fire brick etc and shall be impervious to oil.
- 13.5. The floor of the transformer pit shall be of plain cement concrete of grade M15.
- 13.6. 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.
- 13.7. 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), fire brick or concrete blocks 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 partitions which are made to reduce the noise level of the transformers shall have the same fire resistance as the partitions used as firewalls. 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
    - 14.4.1. The height of firewall shall be minimum 6m 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.
    - 14.4.2. These dimensions might be reduced in special cases, as per the approval of Owner where there is lack of space.
    - 14.4.3. The building walls which act as firewalls shall extend at least 1 m above the roof in order
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to protect it.

### **14.5. Mechanical Resistance**

14.5.1. The firewall shall have the mechanical resistance to withstand local atmosphere conditions.

## **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 300mm above finished yard level.
- 15.1.5. Minimum 75mm 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 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.

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### **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). 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.

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- 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.
- 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 an approved brand of Ligno-sulphonate type admixture.
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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 22.7.1 - DSR 2012.

### 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 25X75mm
- Nominal wire size 6 gauge/ 7.75 kg/m2
- Width of fencing panel 2400mm
- Height of fencing 2000mm
- Fabrication of panels 40mm Nominal bore M.S. Pipe (medium duty). Providing elbow/bend at corners & 40 x 5 mm M.S. flats in beading
- Paint Aluminum Paint

##### 16.4.2. Posts

- Intermediate Straining Post : 65mm Nominal bore, M.S. Pipe (Medium duty)
- Base Plate : 12mm M.S. Plate with 4 nos of hole. Nuts & bolts of suitable diameter.
- Paint : shall be painted with a coat of approved steel primer and two coats of synthetic enamel paint



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The IRC weld mesh Panels shall be fixed to the post at the top and bottom of the 65mm 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, with notches 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. All exposed surfaces of brick toe wall shall be provided with 1:4 cement sand plaster (1 cement : 4 coarse sand) and coated with two coats of Acrylic Smooth exterior paint with a base coat of approved cement primer.

### **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.
  - 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.
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- 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 40mm 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.

### **18.0 MISCELLANEOUS GENERAL REQUIREMENTS**

- 18.1. Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water tightness.
- 18.2. All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.
- 18.3. All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 610 gm/sqm. for galvanized structures and shall comply with IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with IS:2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with IS:3416.
- 18.4. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS: 456 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.
- 18.5. Bricks having minimum 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.
- 18.6. 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 600mm over window & door openings.
- 18.7. 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.
- 18.8. Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting covers, 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.

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- 18.9. Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.
- 18.10. 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.
- 18.11. All underground water retaining concrete structures shall have water proofing cement additive conforming to IS: 2645 water proofing for walls and base slab of all underground concrete structures like basements pump houses etc. shall be by "Injection Method".
- 18.12. All buildings shall have 750mm wide plinth protection all round.
- 18.13. All foundations embedment, inserts, blockouts required for equipments shall be provided by bidder.
- 18.14. 50mm thick DPC shall be provided before laying of masonry (item no. 4.11 & 4.13-DSR 2012).
- 18.15. BSES Display board is to be provided of required size and as per approved pattern /drawing of BRPL with name of the grid.
- 18.16. Water and Sewer line connections to be done along with approval of CIVIC agency.
- 18.17. 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.

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- 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. Although contractor shall provide an underground water reservoir, near the gate of minimum 20 M3 or sufficient capacity for refill of one fire Tanker. The water reservoir shall be provided with complete fire hydrant system (such as high pressure pump, single point fire hydrant outlet, etc) for refilling the fire tender in case of fire and emergency. Necessary valve shall be provided in the outlet.
- 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 agencies
- 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 100m 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 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.
- (b) The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work upto a depth of 2.0 meter from ground level and 345mm 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 5mm thick chequered plate with hinges shall be provided on the openings. Galvanized M.S. rungs of 16mm 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 100 mm diameter medium duty MS/ PVC pipe conforming to IS: 1161 shall be lowered in the

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bore well keeping bail plug towards bottom of bore well. The pipe shall have 1.58mm holes for 4.0 meter length starting from 1.0 meter from bottom of bore well. Holes of 3.0mm 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 3mm to 6mm 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 50mm to 150mm, gravel of size 5mm to 10mm, coarse sand having particle size 1.5mm to 2.0mm and boulders of size not less than 200mm 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 Conservation Act, etc.
- 24.2. Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.
- 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 underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to 1S:9103. In addition, limit on permeability as given in 1S:2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection Method shall be applied for repairing the leakage.
- 24.7. All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.
- 24.8. All tests as required in the standard field quality plans of CPWD or as per sound engineering practices have to be carried out.
- 24.9. 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

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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 15 days. Required number of sets of design calculations, drawings and documents shall be submitted by the Bidder.

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 A1 size or larger size paper and should be legible. The submission shall be

- Three (03) Sets of approved and released for construction drawings/BOQ/Calculation for Owners reference.
- Two (02) 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.

### **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 and 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:

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- (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	1. False flooring as per design requirement/ layout. OR 2. Epoxy paint (Fosroc/ Sika/BASF) 2mm thick over 52 mm thick CC flooring with concrete hardener topping (item no. 11.4- DSR 2012) over an under layer of RCC/CC.	Plastic emulsion Paint on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). For windows/ventilators double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour).
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 or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). For windows/ventilators double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour)
3	Toilet	Anti skid Vitrified tiles with white cement.	DADO glazed tile 2.1m high for toilet, for pantry above working platform up to 750mm.	Oil bound washable distemper on smooth surface applied with putty	Powder coated Aluminium Hindalco or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). For windows/ventilators double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour).
4	Stair	Polished Kota stone	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface	Powder coated Aluminium Hindalco or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). For



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				applied with putty	windows/ventilators double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour).
5	Store 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 or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). For windows/ventilators double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour).
6	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	
7	Switchgear Room	52 mm thick CC flooring with concrete hardener topping (item no. 11.4-DSR 2012) with epoxy paint on top and an under layer of RCC/CC.	Oil bound washable distemper on smooth surface applied with putty	Oil bound washable distemper on smooth surface applied with putty	For windows/ventilators Powder coated Aluminium Hindalco or equivalent extruded sections as per IS 733 & 1285. Glazing with float glass (min 5.5mm thick). Double glazing with 12mm gap hermetically sealed (minimum thickness of powder coating 50 micron of approved colour).
8	Internal doors between GIS Room, Control Room & 11KV Switchgear room shall be fire proof doors. (Fire rating of 120 minutes).				
9	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.				
10	External finishing of the building on area other than the area of stone grit/ Wash Marble using Acrylic Smooth exterior paint (painting) shall be Nerolac excel or equivalent The paint shade as approved by BRPL				

**TECHNICAL SPECIFICATION**  
**FOR**  
**66KV OUTDOOR CIRCUIT BREAKER**

Prepared by	Meenakshi		Rev: 0
Reviewed by	Kiran Alla		Date:
Approved by	Kiran Alla		

## Volume – I Technical Specification for 66KV Outdoor Circuit Breaker

### 1.0 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 Standard

Standard Code	Standard Description
Indian electricity act	Revised edition
CBIP manual	
IS-2516	Specification for circuit. Breaker.
IS-13118-1991	Specification for high voltage altering 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
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

## Volume – I Technical Specification for 66KV Outdoor Circuit Breaker

### 2.0 CIRCUIT BREAKER DESIGN FEATURES

	Description	Requirement / Rating
2.1.0	Contacts	
2.1.1	Making & Breaking Contacts	Hermetically sealed, free from atmospheric effects, adjustable to allow for wear, easily replaceable 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 indicators as well as a mechanical indicator shall be provided for a) Open and close position indication of breaker b) Spring charged indication c) Local / Remote indication 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. An operation counter shall also be provided with each breaker. SF6 gas density monitor shall be provided at 1.5 metre from ground level, tubing between gauge & breaker shall be stainless steel.
2.5.0	Closing Coil	Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage.
2.6.0	Tripping Coil	a) Shunt trip shall operate correctly at all values of supply voltage between 70% and 110% of rated voltage. b) Trip coil shall be suitable for trip circuit supervision, the relay for monitoring which will be provided by the Owner and mounted on control panel. c) Two no's tripping coil shall be provided.
2.7.0	Remote / Local closing & Tripping	a) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. 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.
2.8.0	Manual spring charging	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 direction of motion of handle shall be clearly marked
2.9.0	Spring Operated	a) Complete with motor, opening spring and closing spring with limit

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	Mechanism	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	± 15%
2.10.3	Frequency variation	± 5%
2.10.4	Combined voltage & frequency	± 15%
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. Also castle key and electrical interlock shall be provided with isolators.
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, which shall be IP 55.
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 of GTP.
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	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. Separated stud shall be provided for incoming and outgoing wires. Marking of terminal strips shall correspond to wire number on diagrams. b) Terminal blocks shall be fully enclosed with easily removable cover and made of NYLON 66. 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 c) 20 percent spare terminal blocks shall be provided for Owners 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

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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 flame, vermin and rodent proof. The size of control wire shall be 1.5/2.5 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 block. 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 Owner. 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 closed contacts. The contact shall be able to make and carry 5 Amps at 220V 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 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 IS. b) The earth continuity conductor shall have sufficient cross-sectional area so as to 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 points 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 Owner
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	Glazing of the porcelain shall be of uniform brown colour free from

## Volume – I Technical Specification for 66KV Outdoor Circuit Breaker

	of Bushing	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 stainless steel only
2.18.0	Joints	All joints shall be airtight. Surfaces of 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 31 mm/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 Service condition.
		b) The circuit breakers shall meet the above duty requirements in case of application on U/G cable circuits as also 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 from Owner
2.23.0	Painting	Polyurethane based paints shall be used. The color for the finishing paint shall be light grey as per shade No. 692 of IS-5.
2.24.0	Line side terminal connector	Al-alloy A6 grade terminal connector shall suitable for single/twin ACSR conductor as per GTP in schedule C-17

### 3.0 TESTING & INSPECTION

3.1.0	Tests	Test shall be carried out in accordance with IS 13118 / IEC-56 / IEC-60694 / IEC-62271-100
3.1.1	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. / authorized body then it shall be acceptable for type testing.
3.1.2	Routine test	Test shall be carried out in accordance with IS13118 / IEC-56 / IEC-60694 / IEC-62271-100
3.1.3	Acceptance Test	Test shall be carried out in accordance with IS13118 / IEC-56 / IEC-60694 / IEC-62271-100
3.2.0	Tests on fitting and accessories	As per Manufacturer's Standards

## Volume – I Technical Specification for 66KV Outdoor Circuit Breaker

3.3.0	Inspection & Testing	<p>a) The buyer reserves the right to witness all tests specified on completed product</p> <p>b) The buyer reserve the right to inspect the product at the Sellers works at any time prior to dispatch, to verify compliance with the specifications.</p> <p>c) In-process and final inspection call intimation shall be given in advance to Owner.</p> <p>c) If the manufacturer's lab is accredited by govt. / authorized body then it shall be acceptable for type testing.</p>
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### 4.0 COMMISSIONING SUPPORT

Supervision of Erection and Commissioning inclusive of all testing equipments/instruments shall be included

### 5.0 TRAINING

- a) Training on installation, commissioning, operation and maintenance shall be included in the proposal or quoted as optional items.
- at factory
  - at site after installation

### 6.0 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**  
**11KV INDOOR SWITCHGEAR**  
**NEW GRIDS**

Specification no – SP-HTSWG-01-R1

Prepared by	Hemanshi		Rev: 1
Approved by	Vijay Panpalia		Date: 31 <sup>st</sup> July 2014

## 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: -

Standard Name / No	Standard's Description
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

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3.1.5	Racking in the circuit breaker inhibited	Unless the control plug is fully engaged
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
4.0.0	<b>Surge suppressors</b>	
4.1.0	Provision	To be provided in all panels except bus coupler and BPT

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	Type	Gapless, metal oxide type
<b>5.0.0</b>	<b>Current Transformers</b>	
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.
	CBC	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

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9.2.2	Panels where to be provided	All panels except Bus PT
9.2.3	Ammeter selector switch	To be provided
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 Chapter 35 for technical specification.
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

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		terminals
11.8.1	Emergency trip push button	Red color with stay put
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	100 mm min



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	set of TB	
13.6.0	Test Terminal blocks	Screw driver operated stud type for metering circuit
<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

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		per BSES requirement and signal list only. Refer the attached tentative signal list of all feeders (Incomer , Out 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)
	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	3 phase over current and Earth fault protection with IDMT, Definite time and instantaneous characteristics.
15.1.2	<b>Protection Relays for 11Kv Outgoing panel</b>	
	Relay 1	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	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	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	<b>Auxiliary Relay – General Features</b>	
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	220VDC. All relays / contactors shall be suitable for continuous operation at 15% overvoltage.
18.1.0	<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.
19.1.0	<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
20.1.0	<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 / SIEMENS Numerical relays used in complete switchboard should be of same make.
26.1.2	Auxiliary Electromechanical	ABB / Areva / Schneider

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	Relays	
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)

### 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>o</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 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
2.5.2	Short circuit making current	62.5KA
2.6.0	Operating time	

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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
5.0.3	Rated current	As per application
<b>6.0.0</b>	<b>Surge Arrestors</b>	

**Volume – I Technical Specification for 11KV Indoor Switchgear**

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 OF 66KV CONTROL & RELAY PANEL FOR NEW GRIDS

Specification no – SP-CRP-01-R1

Prepared by	Javed Ahmed		Rev: 2
Reviewed by	Abhinav Srivastava		Date: 29.03.2017
Approved by	Vijay Panpalia		

**Volume – I Technical Specification for 66KV Control & Relay Panel**

**Revision Record**

S.No.	Rev.No.	Item/Clause No.:	Nature of change	Approved By
1	R1	4	Width of cubicle shall be 1250mm	KA
2	R1	5.7	Spare terminal in each type of terminal.	KA
3	R1	6	Test terminal block for numerical relays and meter.	KA
4	R1	8	Mimic diagram alignment with discrepancy type control switch.	KA
5	R1	11.4	Multifunction meter with digital output with modbus communication.	KA
6	R1	11.4.3	Communication protocol IEC 61850 metering equipment.	KA
7	R1	12.1.5	Communication protocol IEC 61850 in Numerical Relays.	KA
8	R1	12.1.9	All necessary converters shall be consider for communication of numerical relays in case of optical fiber.	KA
9	R1	12.1.16	Digital input and output of Numerical relays	KA
10	R1	12.2.1.2	Line current differential with distance relays in Line control and relays panel.	KA
11	R1	12.2	Optical fiber communication in line current differential relays with distance relays in Line control and relays panel.	KA
12	R1	12.4	Auxiliary relays shall NO/NC contact shall be as per BSES requirement.	KA
13	R1	13.0	Minimum no. of annunciation window shall be 24Nos.	KA
14	R2	18.4.1	Addition of Alstom Make Relays	VP

## Volume – I Technical Specification for 66KV Control & Relay Panel

### 2.0 SCOPE OF SUPPLY

- 2.1 This specification covers design, manufacture, testing at manufacturer's works, packing and delivery of control and relay panel for substation equipments.
- 2.2 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 as specified in the Annexure A of data sheet.
- 2.3 Such parts which 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 also included in this specification.

### 3.0 CODES & STANDARDS:

Control and Relay panel should be designed and manufactured in accordance with the following standards –

#### National Standard

Standard Code	Standard Description
IS-1248, Part 1- 1993	Direct acting indicating analogue electrical measuring instruments and their accessories.
IS-3231, Part 1- 1986 Part 2 &3 -1987	Electrical relays for power system protection
IS-9000 Part 1 -1988	Basic environmental testing procedures for electronics & electrical items
IS-13703 1993	Low voltage fuses for Voltages not exceeding 1000V AC or 1500 V DC
IS-13947 Part 1 - 1993	Low voltage switchgear & control gear
IEC-60255 - 1989	Specification for electrical relays
IEC 60688 1997	Electrical measuring transducers

### 4.0 PANEL CONSTRUCTION

	Description	Requirement / Rating
4.1	Panel Type	Simplex panels of standard dimensions. Equipment shall be mounted on the front of the panel and doors for wiring access shall be at the back of panels.
4.2	Enclosure type	Completely metal enclosed and dust, moisture and vermin proof. Degree of protection not less than IP-4X in accordance with IS 13947
4.3	Enclosure material	Cold-rolled sheet steel of thickness not less than 2.0 mm. Stiffeners shall be provided wherever necessary.
4.4	Doors	Doors shall be at the rear. For panels having width should

## Volume – I Technical Specification for 66KV Control & Relay Panel

		be more than or equal to 1250mm, double leaf doors shall be provided. Doors shall have handles with either built-in locking facility or be provided with padlock.
4.5	Gland Plate	At least two separate gland plates of removable type shall be provided for each panel. They shall be of sheet steel of thickness not less than 3.0 mm.
4.6	Cable Entry	Shall be from the bottom
4.7	Gaskets	All doors, removable covers and panels shall be gasketed all around with neoprene gaskets.
4.8	Ventilating louvers	Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wires mesh.
4.9	Foundation	The panels shall be fixed on the embedded foundation channels with intervening layers anti vibration strips made of shock absorbing materials. Base frames shall be supplied along with panels.
4. 10	Mounting	Equipment on front of panel shall be flush mounted. Cutouts if any, provided for future mounting of equipment shall be properly blanked off with blanking plate no equipment shall be mounted on the doors.
4.11	Mounting level	The center lines of switches, push buttons and indicating lamps shall not be less than 750mm and that for relays, meters and recorders shall be not less than 450 mm from the bottom of the panel.
4.12	Appearance	The center lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc, shall be matched.

### 5.0 WIRING

5.1	Internal wiring	1100V grade, single core, stranded copper conductor wires with PVC insulation.
5.2	Size	4 sqmm for CT circuits, 2.5 sqmm for PT and control circuits.
5.3	Colour Code	R ph - Red, Yph - Yellow, B ph - Blue, Neutral - Black for CT and PT circuits. DC - Grey, AC - Black and Earth - Green
5.4	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.
5.5	Termination	Fork type, pin type and ring type (as applicable) tinned copper lugs to be used. Insulated sleeves shall be provided at all the wire terminations.
5.6	Wiring Enclosure	Plastic channels to be used as enclosures. PVC sleeves to be used for inter panel wiring.

## Volume – I Technical Specification for 66KV Control & Relay Panel

5.7	Spare Contacts	Spare contacts of relays and contactors etc. should be wired upto the terminal block
5.8	Inter panel wiring	When panels are arranged adjacent to each other inter panel wiring of common bus wires between the panels shall be furnished. These adjacent inter panel wiring shall be clearly indicated in the wiring tables.
5.9	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.

### 6.0 TERMINAL BLOCKS

6.1	Rating and Type	1100 V grade, minimum 10 amps continuous rating, Nylon 66, molded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. White fiber markings strip with clear plastic, slip-on / clip-on terminal covers to be provided.
6.2	CT & PT Terminals	Terminal Blocks (TB) for current transformer and voltage transformer secondary leads shall be Stud Type provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short-circuiting and earthing facilities.
6.3	Spare Terminals	20% in each type of TB row
6.4	Clearance with gland plate	Minimum 250mm
6.5	Clearance between two TBs	Minimum 150mm
6.6	Test Terminal Blocks	Screw driver operated stud type for each type of numerical relays and metering
6.7	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: 4 sq.mm copper. b) AC / DC power supply circuits: one no. of 10 mm <sup>2</sup> Al./ 6 sq.mm Cu.
6.8	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.

## Volume – I Technical Specification for 66KV Control & Relay Panel

### 7.0 PAINT

7.1	Paint Type	Powder coated. Pure Polyester base Grade-A, structure finish.
7.2	Paint Shade	RAL7032 'Siemens Grey'
7.3	Paint Thickness	Minimum 50 microns

### 8.0 MIMIC DIAGRAM

8.1	System Representation	Colored mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels and it shall be properly align with all discrepancy type control switch of panels.
8.2	Material	Mimic diagram shall be made preferably of painted Aluminum or plastic of approved fast color 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.
8.3	Mimic Indications	Discrepancy type switches are to be used for breaker and isolator control indication and semaphore indicators shall be used for earth switch position.

### 9.0 NAME PLATES & MARKINGS

9.1	Provision of Nameplates	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. Also, 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. 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.
9.2	Nameplate Material	Non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering. Stickers are not allowed.
9.3	Markings	Each switch shall bear clear inscription identifying its function. Similar inscription shall also be provided on each device whose function is not other wise 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-

## Volume – I Technical Specification for 66KV Control & Relay Panel

		Neutral close, ON-OFF, R-Y-B OFF etc.
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### 10.0 EARTHING

10.1	Panel Earthing	All panels shall be equipped with an earth bus securely fixed.
10.2	Material	The material and the sizes of the bus bar shall be 25 x 6 mm copper flat unless specified otherwise.
10.3	Earth Bus joints	All bolted joints in the bus will be affected by connection of two bolts.
10.4	Hinged Doors	Earthed through flexible copper braid.
10.5	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
10.6	CT and PT circuit Earthing	VT and CT secondary neutral shall be earthed at one place only at the terminal blocks through links.

### 11.0 INSTRUMENTS

11.1	Mounting	Flush Mounting
11.2	Scale	Instruments dial shall be with white circular scale and black pointer, black numerals and lettering with red marks at values corresponding to rated values.
11.3	Ammeters and Voltmeters	Taut Band, Moving iron type
11.3.1	Size	96x96mm
11.3.2	Provision	All panels
11.3.3	Selector switch	to be provided
11.3.4	Accuracy Class	0.5 or better.
11.4	Multifunction meter	Three phase 4 Wire - digital type with Modbus Output.
11.4.1	Provision	All panels except bus-coupler
11.4.2	Accuracy Class	0.5 or better.
11.4.3	Communication Capability	Provision as per IEC 61850 Protocol with serial port communication to be made.
11.4.4	Additional facility	Scrolling facility with LCD display for parameters like power factor, kW, kWh, kVA, kVAR, current, voltage etc.

**Volume – I Technical Specification for 66KV Control & Relay Panel**

**12.0 RELAYS**

12.1	Protective Relays - General features	
12.1.1	Technology and Functionality	Microprocessor based with provision for multifunction protection and control, metering, monitoring, User machine interface, communication interface, self-diagnosis functionalities.
12.1.2	Mounting	Flush Mounting, IP5X
12.1.3	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.
12.1.4	Programming and configuration	Relay shall utilize a user friendly setting and operating multilingual software in windows environment with menus and icons for fast access to the data required.
12.1.5	Relay Communication	Serial communication interface for data transfer and configuration PC and SCADA using appropriate protocols as per IEC 61850. And in case of communication through optical fiber then necessary converter needs to be considered.
12.1.6	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.
12.1.7	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.
12.1.8	Fault recording	Facility for recording various parameters of faults with option to set the duration of fault record with maximum no. of data storage facility
12.1.9	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.



**Volume – I Technical Specification for 66KV Control & Relay Panel**

12.1.10	Self diagnosis	Relay shall be able to detect internal failures. A watchdog relay with changeover contact shall provide information about the failure.
12.1.11	Reset Contacts	Self reset contacts except for lockout relays
12.1.12	Operation Indicators	LEDs with pushbutton for resetting.
12.1.13	Auxiliary supply	As per requirement
12.1.13	Operational Data	Bidder shall provide the reference list of the type of relays offered
12.1.14	Spare Contacts	Minimum 20% Spare contacts
12.1.15	Test Facility	Inbuilt with necessary test plugs.
12.1.16	DI / DO of Numerical relay	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 (Incoming/Out going, Transformer & Transformer Monitoring Unit, Buscoupler & Bus PT).
12.1.17	Contacts for Transformer NIFPS	Contacts of NIFPS shall be provided in Transformer panel
12.2	<b>Protective Relays - Requirement</b>	
12.2.1	For 66kV	
12.2.1.1	Bus Bar Protection	Numerical type, mounted on a separate panel with fault recording. CT wise supervision to be provided.
12.2.1.2	Line Panel	Relay-1 Line current Differential function suitable through optical fiber communication, Distance Protection with multiple characteristics i.e Mho , Quadrilateral etc.
		Relay-2 Directional and non- Directional 3-phase over current and earth fault Protection
		Combining the functions of Relays-1 & Relays-2 in single relay is not acceptable
		Synchronizing Check Relay
		Broken Conductor Protection
12.2.1.3	Bus Coupler	3 Phase Over current protection , Earth fault protection
12.2.1.4	Capacitor feeder	Three phase over current protection
		Earth fault protection
		Neutral unbalance (separate relay)
		Under voltage relay
		Over Voltage relay
		Timer for ON time delay.
		Under Current protection

**Volume – I Technical Specification for 66KV Control & Relay Panel**

12.2.1.5	Transformer Feeder/Panel	Relay – 1 • Differential protection, with software based ratio and vector correction without ICT. • REF protection for the star side.
		Relay – 2 • Overcurrent protection • Earth fault protection • Standby Earth fault protection
		Relay – 3 Transformer monitoring relay including AVR Features or equivalent & the no. of DI / DO Shall be as per BSES Requirement
		Relay 1, 2 & 3 are separate relays. Combining all the functions of relay 1, 2&3 in a single relay is not acceptable
12.3	<b>Auxiliary relays - General Features</b>	
12.3.1	Type	Static or electromechanical.
12.3.2	Reset Characteristic	Self reset contacts except for lockout relays
12.3.3	Operation Indicators	Hand reset operation indicators or LEDs with pushbutton for resetting.
12.3.4	Lockout relay	Manual reset type
12.3.5	Auxiliary supply	As per requirement
12.3.6	Operational Data	Bidder shall provide the reference list of the type of relays offered
12.3.7	Spare Contacts	As per requirement of BRPL
12.4	<b>Auxiliary relays - Requirement</b>	
12.4.1	Each Panel	To be provided with anti-pumping (94), Lockout (86), DC fail (80) and trip circuit supervision (95) relays.
12.4.2	Each Panel	Provision for multiplication of auxiliary contact of breakers, isolators and earth switches to be made in each panel using latching relays. Multiplied contacts to be used for interlocks and indications. NO / NC Contact which shall be use for contact multiply shall be as per protection scheme requirement.
12.4.3	Incoming and Outgoing Feeder Panels	Provision of PT supply supervision and suitable automatic selection scheme between Line PT and Bus PT supplies for uninterrupted metering.

**13.0 ANNUNCIATION**

13.1	Type	Static type along with alarm. Annunciations shall be repetitive type and shall be capable of registering the fleeting signal. Facia test facility
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## Volume – I Technical Specification for 66KV Control & Relay Panel

		should also be provided
13.2	Mounting	Flush mounted
13.3	Facia	Minimum 24 Nos. Facia along with appropriate labels on each facia.in each panel
13.4	Push Buttons	Push buttons for test, accept and reset to be provided
13.5	Potential Free Contacts	To be provided for event logger

Sequence of operation of the annunciator shall be as follows:

S No	Alarm Condition	Fault Contact	Visual Annunciation	Audible Annunciation
1.	Normal	Open	Off	Off
2.	Abnormal	Close	Flashing	On
3.	Accept	Close	Steady on	Off
4.	Return to normal	Open	Steady On	Off
5.	Reset	Open	Off	Off
6.	Reset before return to normal	Close	Flashing	On

### 14.0 INDICATIONS

14.1	Indicating Lamps	Flush mounted Clustered LED type with rear terminal connections. Lamp Cover to be screwed type an moulded from heat resistant material
14.1.1	Breaker On	Red
14.1.2	Breaker Off	Green
14.1.3	Spring Charged	Blue
14.1.4	DC control supply fail	Amber
14.1.5	Auto trip	Amber
14.1.6	Heater Circuit healthy	Yellow
14.1.7	Trip Circuit Healthy	White
14.1.8	PT supply	R, Y, B
14.1.9	Hooter with isolation switch	For AC and DC supply failure
14.2	Position Indicators	Semaphore type indicators shall be provided for mimic diagrams

### 15.0 SELECTOR SWITCHES & PUSH BUTTONS

15.1	Selector Switch	All the selected selector switch shall be only discrepancy type Flush Mounted with shrouded terminals
15.1.1	TNC Switch	Pistol Grip type, Lockable with spring return to normal position
15.1.2	Local/SCADA selector switch	4 pole
15.1.3	Ammeter selector switch	6way 7 position
15.1.4	Voltmeter selector switch	6 way 7 position

## Volume – I Technical Specification for 66KV Control & Relay Panel

15.1.5	Rotary On/Off Switches	For heater/illumination circuit
15.1.6	Rating of switches	16 A
15.2	Push button	Flush Mounted with shrouded terminals
15.2.1	Accept Push Button	Black Color-Trip alarm/DC fail alarm
15.2.2	Reset Push Button	Yellow Color- Trip alarm/DC fail alarm
15.2.3	Test Push Button	Blue Color
15.2.4	Rating	10A

### 16.0 ACCESSORIES

16.1	Space heaters	Thermostat controlled with switch for isolation
16.2	Socket and switch	240V, 5A socket to be provided in each panel with on-off switch
16.3	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.
16.4	Panel illumination	240V AC illumination lamp controlled by panel door switch to be provided in each panel

### 17.0 TESTING & INSPECTION

17.1	Type tests	Product must be type tested as per Indian Standards or IEC
17.1.1	Type test report validity	Last five years from the date of bid submission
17.2	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.
17.3	Notice to Purchaser for conducting tests	At least three weeks in advance
17.4	Test reports of acceptance and routine test before dispatch	Six copies to be submitted.
17.5	Stage and Final Inspection	All the Qty. of Panels will be inspected by BSES as per approved QAP .
17.6	Submission Of QAP	QAP will be submitted by suppliers with submission of Schematic Drawings.
17.7	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
17.8	Training	Training on relays and equipment operations shall be provided to the officials of BRPL will be in the Scope of Suppliers.

**Volume – I Technical Specification for 66KV Control & Relay Panel**

**18.0 DRAWINGS & DATA SUBMISSION**

<b>18.1</b>	<b>Submissions along with the bid</b>	
18.1.1	Duly filled GTP and copy of specification/ Bill of material	2 copies + 1 soft copy
18.1.2	GA/ Cross sectional drawing of panel/SLDs/ Wiring diagrams	2 copies + 1 soft copy
18.1.3	Calculations for MCBs, MCCBs, Fuses and stabilizing resistors etc	2 copies + 1 soft copy
18.1.4	Catalogues and Manuals for all equipments	1 copy
18.1.5	Test Reports	2 copies
18.1.6	Deviations from this specification	
18.1.7	Type test report	For type, size and rating of equipment offered.
18.1.8	Reference List of customers	For last five years with units of similar design and rating
18.1.9	Recommended spares and consumables	For five years of operation along with price list
18.1.10	Manufacturer's quality assurance program	To be provided
<b>18.2</b>	<b>Submissions after award of contract</b>	
18.2.1	Duly filled GTP and copy of specification/ Bill of material	4 copies
18.2.2	GA/ Cross sectional drawing of panel/SLDs/ Wiring diagrams	4 copies
18.2.3	Calculations for sizing of various equipment	4 copies
18.2.4	Catalogues and Manuals for all equipments	1 copy
18.2.5	Deviations from this specification	Approved in writing before award of contract
18.2.6	Foundation Plan	
18.2.7	Calculations for sizing of various components	Showing all views and sections
18.2.8	Type test reports	For all brought out items
<b>18.3</b>	<b>Submissions prior to dispatch</b>	
18.3.1	Inspection and test reports/ compliance report by manufacturer	1 set
18.3.2	As Built drawings/GA/SLDs and Wiring diagrams	6 copies + 1 soft copy
18.3.3	Calculations for sizing of various equipment	6 copies + 1 soft copy
18.3.4	Catalogues and Manuals for all equipments	6 copies + 1 soft copy
18.3.5	Test certificates	6 copies + 1 soft copy
18.4	Drawing and document sizes	Standard size paper A3 and A4
<b>18.4.0</b>	<b>Approved Make of components for 66 KV Switchgear Panel</b>	
18.4.1	Numerical Relays	ABB / SIEMENS/Schneider /Alstom Note: Approval of Selection of Relay Type , make and its Cortex code shall be taken during bid evaluation.
18.4.2	Auxiliary Electromechanical Relays	ABB / Areva / Schneider
18.4.3	Contactors / Auxiliary Relays	Schneider Electric / Siemens / ABB

## Volume – I Technical Specification for 66KV Control & Relay Panel

18.4.4	Analog Ammeter / Voltmeter	AE / Rishabh
18.4.5	Indication Led , Lamp	Teknic
18.4.6	Push Button	Teknic
18.4.7	Field Terminal Block	Phoneix / Elemex / Connect well
18.4.8	MCB	Schneider / Siemens / L&T/ABB
18.4.9	Hooter	Alan
18.4.10	Panel Light	Philips / Bajaj / Surya
18.4.11	Power Socket	Anchor / Reputed make
18.4.12	Multifunction Meter	Rishab / Socomec
18.4.13	Wires for wiring	KEI / Polycab / Finolex
18.4.14	Test Terminal Block	Areva / IMP/Nelster
18.4.15	Control Switch	Areva / Switron
18.4.16	Annuciator Window	Alan / Minilec
18.4.17	Discrepancy switch	Multimode/As per approved BRPL makes during drawing approval.

## 19.0 INSPECTION

Cost of Inspection including flight tickets and lodging (Hotel minimum 3 Star) shall be in scope of Vendor

## 20.0 TRAINING AND COMMISSIONING SUPPORT

a) Supervision of Erection, Testing and Commissioning inclusive of all testing equipment/ instruments shall be included in the bid/proposal.

All Hardware and softwares including Relay setting files and other support shall be in the scope of Vendor.

b) Training of buyers officials (6 officials) on operation and maintenance including relay setting/operations at site (after installation) shall be included in the proposal/bid

## 21.0 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**

**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 & disconnectors for shunt capacitors
IS 2705 & IS3156	Current transformers & RVT
IS 13067	Impregnant 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**  
**FOR**  
**LIGHTNING ARRESTERS**

Prepared by	Hemanshi		Rev: 0
Reviewed by	Abhinav Srivastava		Date: 2.11.2013
Approved by	Vijay Panpalia		

## Volume – I Technical Specification for Lightning Arrestor

### 1.0 CODES & STANDARDS:

Materials, equipment and methods used in the manufacturing of Lightning Arresters shall confirm the latest edition of following standard: -

#### National Standard

Standard Code	Standard Description
	Indian Electricity Rules (relevant safety regulation of CEA)
	Indian Electricity Act 2003
	CBIP manual
IS: 3070 Part-3	Lightning Arresters for Alternating Current Systems
IS : 2071 - Part I	Method of high voltage testing
IS : 2629 -1985	Recommended practice for Hot-Dip Galvanizing of Iron and Steel
IS : 5621 – 1980	Hollow insulators for use in electrical equipment
IS : 6639 - 1972	Specification for Hexagon bolts for Steel structures

#### International Standard

Standard Code	Standard Description
IEC 60099-4-2001	Metal-Oxide surge arresters without gaps for AC system

### 2.0 DESIGN FEATURES

S No	Description	Requirement / Rating
2.1	Application	To be used for protection of transformers, circuit breakers and other sub-station equipment against lightning and switching surges.
2.2	Type of Lightning Arrester	Gap-less metal oxide type (ZnO type)
2.3	Pressure relief device	Pressure relief device of class 40 KA shall be provided
2.4	Accessories	Clamps and counter
2.5	Mounting	LA mounting vertically on steel structures with insulating bases. Surge counters in weather proof enclosures suitable for mounting on structure of lightning arrester
2.6	Line-side Terminal Connectors	Suitable for ACSR Zebra/ Goat conductor / Pipe Bus
2.7	Ground Terminal Connectors	Suitable for 50x6 mm GS flat
2.8	Surge Counter	Non – resettable type

## Volume – I Technical Specification for Lightning Arrestor

2.9	Name Plate Marking	Following minimum information must be marked – i) Name of the manufacturer ii) Type and serial No. iii) Model No. iv) Rated voltage v) Max. continuous Operating Voltage vi) Nominal discharge current vii) Pr. Relief Current viii) Identification mark on each separately housed unit to enable it to be replaced in correct position after the multiunit arrester has been dismantled.
<b>3.0</b>	<b>Approved make of Components</b>	
3.1	Insulators	JS / WSI / BHEL / Modern / Saravana
<b>4.0</b>	<b>Testing &amp; Inspection</b>	
4.1	Internal Test	Manufacturer shall carry out comprehensive inspection and testing during manufacturing of the equipment.
4.2	Type test	The product must be of type tested quality. Type test reports shall be submitted for the type, size & rating of equipment offered along with bid. If the manufacturer's lab is accredited by Govt./ authorized body then it shall be acceptable for type testing
4.3	Routine test	As per relevant IS / IEC
4.4	Acceptance test	as per relevant IS / IEC
4.5	Test Witness	
		The buyer reserves the right to witness all tests specified on completed product
		The buyer reserve the right to inspect the product at the sellers works at any time prior to dispatch, to verify compliance with the specifications.
		In-progress and final inspection call intimation shall be given in advance to Owner.
4.6	Tests on Fitting and Accessories	As per manufacturer's standard and relevant IS / IEC

### 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**  
**STRUCTURAL WORK**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume – I Technical Specification Structural Work**

### **1.0 GENERAL**

- 1.1 The scope of specification covers design fabrication, proto assembly, supply and erection of galvanized steel structures for towers, girders, and equipment support structures, towers which shall be lattice type structures fabricated from structural steel conforming to IS: 2062(latest) The scope shall include supply and erection of all types of structures including bolts, nuts, washers, hangers, shackles, clamps, anti climbing devices, bird guards, step bolts, inserts in concrete, gusset plates equipment mounting bolts, structure earthing bolts, foundation bolts, spring and flat washers, fixing plates and any other items as required to complete the job.
- 1.2 The connection of all structures to their foundations shall be by base plates and embedded anchor/foundation bolts. All steel structures and anchor anchor/foundation bolts shall be galvanized. The weight of the zinc coating shall be at least 0.610 Kg/m<sup>2</sup> for anchor bolts/foundation bolts and for structural members. One additional nut shall be provided below the base plate which may be used for the purpose of leveling.

### **2.0 DESIGN REQUIREMENTS FOR STRUCTURES**

- 2.1 For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on IS: 802 Part 1 Sec 1
- 2.2 For material and permissible stresses IS: 802, Part-1, Section-2 shall be followed in general. However additional requirements given in following paragraphs shall be also considered.
- 2.3 Minimum thickness of galvanized tower member shall be as follows:
- | Member                    | Minimum thickness (mm) |
|---------------------------|------------------------|
| Leg members, ground wire  | 5                      |
| Peak members/main members |                        |
| Other members             | 4                      |
| Redundant members         | 4                      |
- 2.4 Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per IS-802
- 2.5 Minimum distance from hole center to edge to adjacent hole shall be minimum 1.5 X bolt diameter. Minimum distance between center to center of holes shall be 2.5 x bolt diameter.
- 2.6 The minimum bolt diameter shall be 16 mm.

## **Volume – I Technical Specification Structural Work**

### **2.7 Step Bolts**

In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each tower shall be provided with step bolts not less than 16mm diameter and 175mm long spaced not more than 450mm apart, staggered on faces on one leg extending from about 0.5M above ground level to the top of the tower. The step bolt shall conform to IS: 10238

### **2.8 Design Criteria**

- a) All structures be designed for the worst combination of dead loads, live loads, wind loads as per code IS 802 seismic forces as per code IS : 1893, importance factor of 1.5, loads due to deviation of conductor, load due to unbalanced tension in conductor, torsion load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces shall be calculated considering a fault level of 31.5KA for 3 secs. IEC-865 may be followed for evaluation of short circuit forces.
- b) Switchyard girders structure shall be designed for the two conditions i.e. normal condition and short circuit condition. In both conditions the design of all structures shall be based on the assumption that stringing is done only on one side i.e. all the three (phase) conductors broken on the other side. Factor of safety of 2.0 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switchyard structures, which are of lattice type.
- c) Vertical load of half the span of conductors/string and the earth wires on either side of the beam shall be taken into account for the purpose of design. Weight of man with tools shall be considered as 150KGs for the design of structures.
- d) Terminal / line take off girders shall be designed for a minimum conductor tension of 1000Kg per sub conductor per phase for 66KV. The distance between terminal girders and the dead end tower shall be taken as per standard. The design of these terminal girders shall also be checked considering +/- 30 deg deviation of conductor in both vertical and horizontal planes. For other girders the structural layout requirements shall be adopted in design.
- e) The girders shall be connected with lattice columns be bolted joints.
- f) All support structures used for supporting equipments shall be designed for the worst combination of dead loads, erection load. Wind load/seismic forces, short circuit forces. Short circuit forces shall be calculated considering a fault level of 31.5KA for 3 seconds.
- g) Foundation bolts shall be designed for the loads for which the structures are designed



## **Volume – I Technical Specification Structural Work**

### **3.0 DESIGN DRAWINGS, BILL OF MATERIAL & DOCUMENTS**

- 3.1 The contractor shall furnish design, drawing and BOMs to the Owner after award of the contract. However contractor shall have to prepare and submit any other drawings, bill of material additionally required during design and construction stage which the Owner feels necessary. In case Owner feels that any design drawing, BOM are to be modified even after its approval, contractor shall modify the design & drawings and resubmit the design drawing, BOM as required in the specification.
- 3.2 The fabrication drawings are to be provided and furnished by the contractor shall be based on design approved by Owner. These fabrication drawings shall be based on the design approved by the Owner. These fabrication drawings shall indicate complete details of fabrication and erection including all erection splicing details, lacing details, weld sizes and lengths. BOM in the Performa approved by the Owner shall be submitted. Bolt details and all customary details in accordance with standard structural engineering practice whether or not given by the Owner.
- 3.3 The fabrication work shall start only after the final approval to the design and drawings is accorded by the Owner. The design drawing should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints.
- 3.4 Such approval shall however not relieve the contractor his responsibility for the safety of the structure and good connections and any loss or damage occurring due to defective fabrication design or workmanship shall be borne by the contractor.

### **4.0 FABRICATION OF STEEL MEMBERS**

- 4.1 The fabrication and erection works shall be carried out generally in accordance with IS 802. A reference however may be made to IS 800 in case of non-stipulation of some particular provision in IS 802. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

### **5.0 PROTO – ASSEMBLY**

- 5.1 The component parts shall be assembled in such a manner that are neither twisted not otherwise damaged and shall be so prepared that the specific camber, if any, is provided. In order to minimize distortion in member the component parts shall be positioned by using the clamps, Clips, lugs, jigs and other suitable means and fasteners (bolts and weld) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.
- 5.2 Sample towers, beams and lightning masts and equipment structures shall be trial assembled in the fabrication shop and shall be inspected and cleared by contractor based on the design approval accorded by the Owner before mass fabrication.

## **Volume – I Technical Specification Structural Work**

- 5.3 Pursuant to above the BOM's along with proto-corrected fabrication drawing shall be prepared and submitted by the main vendor to Owner as document for information. Such BOM, which shall be the basis for the Owner to carry out inspection.

### **6.0 BOLTING**

- 6.1 Every bolt shall be provided with two flat and one spring washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together. Locking nut shall be provided with each grouting bolt.
- 6.2 All steel items, bolts, nuts and washers shall be hot dip galvanized.
- 6.3 2.0% extra nuts and bolts shall be supplied for erection.

### **7.0 WELDING**

- 7.1 The work shall be done as per approved fabrication drawings, which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld etc. Symbols for welding on erection and shop drawings shall be according to IS 813. Efforts shall be made to reduce site welding so as to avoid improper joints due to constructional difficulties.

### **8.0 FOUNDATION BOLTS**

- 8.1 Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.
- 8.2 The contractor shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers/structures are plumb.
- 8.3 All foundation bolts for lattice structures are to be supplied by the contractor.
- 8.4 All foundation bolts shall be fully galvanized so as to achieve 0.610 kg. Per Sq.m. of Zinc coating as per specifications.
- 8.5 All foundation bolts shall conform to IS 5624 but the material shall be MS conforming to IS 2062.

### **9.0 STABILITY OF STRUCTURES**

The method of grouting the column bases shall be subject to approval of Owner and shall be such as to ensure complete uniformity of contact over the whole area of the steel base. The contractor will be fully responsible for the grouting operations.

## **Volume – I Technical Specification Structural Work**

### **10.0 GROUTING**

The method of grouting the column bases shall be subject to approval of Owner and shall be such as to ensure complete uniformity of contact over the whole area of the steel base. The contractor will be fully responsible for the grouting operations.

### **11.0 GALVANISING**

- 11.1 All structural steel works and support shall be galvanized after fabrication.
- 11.2 Zinc required for galvanizing shall have to be arranged by the manufacturer. Purity of zinc to be used shall be 99.95% as per IS 209.
- 11.3 The contractor shall be required to make arrangement for frequent inspection by the Owner as well as continuous inspection by a resident representative of the Owner, if so desired for fabrication work.

### **12.0 TOUCH UP PAINTING**

The touch up primers and paint shall consist of Zinc phosphate / Zinc chromate conforming to the requirements of IS 2074 with a pigment to be specified by the Owner.

### **13.0 INSPECTION BEFORE DESPATCH**

- 13.1 Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by the Owner or his authorized representative as satisfactory before it is dispatched to the erection site.
- 13.2 Such certification shall not relieve the contractor of his responsibility regarding adequacy and completeness of fabrication.

### **14.0 TEST CERTIFICATE**

Copies of all test certificates relating to material by the contractor for the works shall be forwarded to the Owner.

### **15.0 ERECTION**

The contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipments and all other accessories and ancillaries required for carrying out erection without causing any stresses in the members which may cause deformation and permanent damage.

## **Volume – I Technical Specification Structural Work**

### **16.0 SAFETY & PRECAUTION**

The contractor shall strictly follow at all fabrication, transportation and erection of steel structures, raw m, materials and other tools and tackles, the stipulations contained in Indian standard code for safety during erection of structural steel work.

### **17.0 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 OUTDOOR SWITCHYARD MATERIAL

Prepared by			Rev: 1
Reviewed by			Date:
Approved by			

## **Volume – I Technical Specification Outdoor Switchyard Material**

### **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 F.O.R site of 66KV Outdoor Switchyard Material and Hardware complete with all accessories for efficient and trouble free operation.
- 1.2 In the event of any discrepancy between listed documents, the stipulation of this specification shall govern.
- 1.3 The specification shall be read and constructed in conjunction with other sections of bidding document.

### **2.0 SCOPE OF WORK**

#### **2.1 Scope of Supply**

Type, rating, connections etc. of the materials shall be as detailed in the drawings and annexure. The materials shall be furnished in strict compliance with the same.

#### **2.2 Following materials and hardware's are to be furnished:**

- a) ACSR ZEBRA Conductor
- b) Aluminum Pipe.
- c) G.S Shield Wire
- d) Tension & Suspension Insulator String Assembly Sets
- e) Disc Insulator & Post Insulators
- f) Conductor Spacers, Clamps, Connectors.
- g) Bay Marshalling Kiosk.

Any material or accessory, which may not have been specifically mentioned but which is usual and / or necessary shall be supplied free of cost to the Owner.

### **3.0 GENERAL REQUIREMENTS**

#### **3.1 Codes and Standards**

- i) All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) & IEC Standard except where modified and / or supplemented by this specification.

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- ii) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such cases, copies of the English version of the standard adopted shall be submitted along with the bid.
- iii) The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition other rules or regulations applicable to the work followed. In case of any discrepancy, the more restrictive rule shall be binding.

### **4.0 DESIGN CRITERIA**

- 4.1 All the ACSR conductors, disc and string insulators, clamps & connectors, hardware's etc. will be used in extra high voltage system having characteristics as listed in the annexure.
- 4.2 All equipments, conductors, hardware's, insulators & clamps etc. will be installed outdoor in a hot, humid & tropical atmosphere.
- 4.3 The maximum temperature in any part of the clamps, connectors, conductors etc at specified rating shall not exceed the permissible limit as stipulated in the relevant standards.
- 4.4 All equipments, conductors, clamps, connectors, insulators etc shall be capable of withstanding the dynamic & thermal stresses of maximum short circuit current without any damages or deterioration.
- 4.5 In order to avoid concentration of stresses, all sharp edges of clamps, connectors etc. shall be rounded off.
- 4.6 Bi-metallic connectors shall be used for any connection between dissimilar materials.

### **5.0 SPECIFIC REQUIREMENT**

#### **5.1 Equipment & Materials**

- i) Equipment & material shall comply with description, rating etc. as detailed in this specification and annexure.
- ii) All accessories, fittings, supports, bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.
- iii) All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.
- iv) After the treatment of steel surfaces damaged during transit sufficient quantity of anti-corrosive paint shall be applied and subsequently finished with two coats of final paint of approved shade.

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### **5.2 ACSR Conductor**

- i) The Aluminum Standard conductor and steel reinforced shall have the technical parameters matching with the requirements given in Annexure. ACSR conductors shall conform to the latest revision of IS-398.
- ii) The material for ACSR conductor shall conform to the following:

#### **Aluminum**

The Aluminum strands shall be hard drawn from electrolytic Aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

#### **Steel**

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition:

#### **Element -% Composition**

Carbon - 0.50 to 0.85 Manganese - 0.50 to 1.10 Phosphorous -not more than 0.035  
Sulphur -not more than 0.045 Silicon - 0.10 to 0.35

#### **Zinc**

The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS: 209-1979.

### **5.3 Clamps and connectors**

- i) All clamps, connectors and hardware's shall be designed manufactured and tested as per relevant standards.
- ii) All clamps & connectors for connection with Aluminum Pipe/ACSR conductors shall have high tensile Aluminum alloy grade A6 body. U- Bolt and nut for the clamp shall be made of non-magnetic material e.g. chromium steel.
- iii) Bolt, nut, washer, shackle etc. required for other purpose shall be of forged steel with adequate strength and the surface shall be so protected as to offer maximum resistance to corrosion. Malleable iron wherever used for any part shall be of best quality and shall correspond to latest amendments of relevant IS.
- iv) Various fittings & accessories of the clamps & connectors shall be so designed as to eliminate sharp edges & maintain bright smooth surface. All bolts, nuts, rivets etc. shall have round profiles.

### **5.4 Disc Insulator**

- i) All disc insulators shall be dimensioned appropriately so as to have the required Electro- Mechanical strength for EHV outdoor duties.



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- ii) Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Glazing of the porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects. Insulators shall be interchangeable and shall be suitable for forming either suspension or strain strings. Each insulator shall have rated strength markings on porcelain printed and applied before firing.
- iii) When operating at normal rated voltage there shall be no electric discharge between conductor and insulator which would cause corrosion or injury to conductors or insulators by the formation of substances due to chemical action. No radio interference shall be caused when operating at normal rated voltage.
- iv) Insulating shall be co-ordinated with basis impulse level of the system. The creepage distance shall correspond to very heavily polluted atmosphere (31mm/KV)
- v) Porcelain used in insulator manufacture shall be homogeneous, free from lamination, cavities and other flaws or imperfection that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- vi) 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. All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS: 209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfection such as flux, ash, rust stains bulky white deposits and blisters.
- vii) Bidder shall make available data on the essential features of design including the method of assembly of discs and metal parts, number of discs per insulators, the manner in which mechanical stresses are transmitted through discs to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.
- viii) Insulator hardware shall be of forged steel. Malleable cast iron shall not be accepted except for insulator disc cap. The surface of hardware must be clean, smooth, without cuts, abrasion or projections. No part shall be subjected to excessive localized pressure. The metal parts shall not produce any noise generating corona under operating conditions.
- ix) The insulator hardware assembly and clamps shall be designed for 120KN Tensile load. The clamps shall be designed for 700 Kg tensile load. Earth wire tension clamp shall be designed for 1000 Kg tensile load with a factor of safety of two (2).
- x) The tension string assemblies shall be supplied along with suitable turn buckle.

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### **5.5 Post Insulator Stack**

- i) Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.
- ii) Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfection that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- iii) Glazing of the Porcelain shall be of uniform brown in color, free from blisters, burrs and other similar defects.
- iv) The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC-815 for the specified pollution level.
- v) When operating at normal rated voltage there shall be no electric discharge between conductor and insulators, which would cause corrosion or injury to conductors or insulators by the formation of substances produced by chemical action.
- vi) The design of the insulators shall be such that stress due to expansion and contraction in any part of the insulator shall not lead to deterioration.
- vii) All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS: 2633 & IS: 4579. The zinc used for galvanizing shall be grade Zn 99.95 as per IS: 209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections.
- viii) If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the manufacturer.
- ix) Post insulator shall be complete with necessary fixing clamp at top for clamping of ACSR conductor, as required. The insulators shall be provided with necessary nuts, bolts and washers.

### **5.6 Galvanized Steel Shield Wire**

- i) Galvanized steel shield wire shall generally conform to IS 398 (Part-II) except as specified herein and in annexure. The steel strands shall be drawn from high carbon steel rods produced by either acid or basic open hearth process, the electric furnace process or basic oxygen process. The wire shall be hot dip galvanized.

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- ii) Zinc used for galvanizing shall be electrolytic high-grade zinc of 99.5% purity and shall conform to IS: 209 -1966. The hot dip galvanizing shall be done as per IS: 4826 - 1968 for heavy coating.
- iii) There shall be no joint of any kind in the finished strand wire entering into the construction of earth wire.
- iv) The wire shall be 7/8SWG galvanized steel wire. The ultimate strength of individual strand shall not be less than 1000 Kgs.

### **5.7 Bundle Spacers**

- i) Bundle spacers shall have enough strength so as to restore normal spacing of conductors after displacement by winds, short circuits etc. without damages or permanent deformation. The spacers shall have long life without fatigue or wear and shall have gentle but firm grip on conductor. They shall be able to withstand all the electromagnetic and electrostatic forces under different operating conditions including dead short circuit
- ii) They shall be one-piece construction and shall not have separate small components.
- iii) The materials used in spacers shall be corrosion resistant and made of Aluminum alloy grade A6.
- iv) The spacers shall be flexible enough so as to avoid distortion or damages to the conductor or themselves. Rigid spacers are not acceptable.

### **5.8 Marshalling Kiosk**

- i) Marshalling Kiosk shall be furnished for each bay of 66KV switchyard. It is intended to have all interlocking circuit, CT & PT connections (for star point) AC, DC distribution in each bay through this cubicle. For this purpose, adequate terminals shall be provided in this cubicle. The terminal blocks shall be installed at least at a height of 200mm from bottom gland plate and gap between two terminal blocks shall be at least 150mm.
- ii) The cubicle shall be outdoor type having IP-55 class of protection with suitable canopy of gasketed weatherproof construction fabricated from sheet steel minimum 2mm thick.
- iii) The marshalling Kiosk shall have three distinct compartments for the following purpose:
  - a) To receive two incoming 415V, 3phase, 32A, AC supply with auto changeover and MCB unit and distribute 5 nos., 415V, 16A, AC supplies controlled by MCB

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- b) To distribute 5 nos., 240V, 10A, single phase supplies to be controlled by MCB and drawn from above 3 phase incomers.
- c) 150nos. terminals blocks in vertical formation for interlocking facilities.
- d) To receive 220V DC, two incoming supply and distribute the same to all the circuit breaker, isolator and transformers of each bay.
- iv) The cubicle shall have front access door with lock and key and removable gland plate at the bottom for cable entry Internal illumination lamp and 3- pin 5A socket with individual ON-OFF switches shall be provided in the cubicle
- v) Suitable space heater with thermostat shall be provided to prevent condensation.
- vi) The cubicle shall be epoxy painted to shade 692 of IS 5.

### **5.9 Junction Box for CT, PT & CVT**

- i) CT/CVT/PT separate junction box is not required. Instead the marshalling Kiosk can be used for CT/PT/CVT connection. Although the contractor if wants to can also use junction Boxes for these connection. The Boxes shall outdoor type having IP-55 class of protection with suitable canopy of gasketed weatherproof construction fabricated from sheet steel minimum 2mm thick.
- ii) The box shall have front access door with lock and key and removable gland plate at the bottom for cable entry.
- iii) The junction box shall have stud type (non disconnecting) terminals. Arrangement shall be provided for shorting of the secondary terminals while the CT is in energized condition for testing and other purposes, if necessary. Sufficient space shall be provided so that all terminals are accessible. No. of terminals shall be 20 nos. each in a terminal block and 5 nos. such blocks in CT junction box and 3 nos. such terminal blocks in CVT junction box.
- iv) All incoming and outgoing connections in the junction box shall be properly marked with ferrules.
- v) The box shall be epoxy painted to shade 692 of IS 5

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### 5.10 Aluminum Pipe Busbar

#### 5.10.1 Codes and Standards:

Standard Name / No	Standard's Description
IS 2678	Dimensions and tolerances for wrought aluminium and aluminium alloy drawn round tube
IS 738	Wrought aluminium alloys, drawn tube for general engineering purposes

#### 5.10.2 Erection of Aluminum Pipe Busbar

- i) Aluminum pipes are used for 66kV bus bar jumpers and interconnections at 66 kV Grid Substation. The nominal outer diameter of the pipes is 80 mm and wall thickness 8 mm.
- ii) The minimum height of the 66 kV main bus is 6.4 meters.
- iii) Longitudinal connection between the pipes for main Busbar shall be either by Welding or by flexible jumpers of suitable Size/Rating.
- iv) Welding to pipes should be done on ground using straight run couplers.
- v) In case the bus height changes, then the pipes at the different levels shall be welded together with a piece of pipe using appropriate angular couplers (90° or 135°) prior approval to be obtained from purchaser.
- vi) Suitable vibration damper should be placed/inserted in the pipe busbar.
- vii) Jumpers from equipment to equipment and from equipment to bus shall be either direct by connected or supported on post insulators. One Jumper shall be a single continuous length of Pipe.
- viii) If required length of jumpers is more than one pipe length and where angles are required to be given in the jumpers, welding of aluminum pipe to pipe or pipe to angular connectors shall be done.
- ix) All the open ends of pipes shall be closed with corona end shields.
- x) All joints/Coupling shall be done meeting the best Industrial practices/Standards
- xi) Each and every joint shall be subjected to:
  - a) Physical examination.
  - b) Liquid penetration test.

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### **6.0 TESTS**

#### **6.1 Routine Tests**

- i) During manufacture and on completion of all equipment, conductors, insulators, clamps, connectors and accessories shall be routine tested as per applicable standards at manufacture's works.
- ii) The suspension and tension strings, insulator discs and hardware shall be subjected to the following, acceptance tests and routine tests:
  - a) Visual examination
  - b) Verification of Dimensions as per Cl no. 10.5 of IS: 731
  - c) Temperature cycle test as per Cl no. 10.6 of IS: 731
  - d) Puncture test as per Cl no. 10.10 of IS: 731
  - e) Galvanizing test as per Cl no. 10.12 of IS: 731
  - f) Mechanical performance test as per IEC-575 Cl. 4
  - g) Test on locking device for ball & socket coupling as per IEC-372 (2)
  - h) Porosity test as per Cl no. 10.11 of IS: 731

#### **Acceptance Tests**

- a) Visual examination as per Cl. 5.10 Of IS: 2468 (Part-1)
- b) Verification of Dimensions as per Cl. 5.8 Of IS: 2468 (Part-1)
- c) Galvanizing / Electroplating test as per Cl. 5.9 Of IS: 2468 (Part-1)
- d) Slip strength test as per Cl. 5.4 Of IS: 2468 (Part-1)
- e) Shore hardness test for the Elastomer (if applicable as per the value guaranteed by the Bidder)
- f) Mechanical strength test for each component (including grading rings and arcing horns).
- g) Test on locking devices for ball and socket coupling as per IEC: 372 (2)

#### **Routine Tests on Disc Insulator / Long rod Insulator**

- a) Visual Inspection as per Cl No. 10.13 of IS: 731
- b) Mechanical Routine Test as per Cl No. 10.14 of IS: 731
- c) Electrical Routine Test as per Cl No. 10.15 of IS: 731

#### **Routine Tests on Hardware Fittings**

- a) Visual examination as per Cl. 5.10 Of IS: 2468 (Part-1)
- b) Mechanical strength Test as per Cl. 5.11 Of IS: 2468 (Part-1)

#### **Test during manufacture on all components as applicable on Disc Insulator**

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- a) Chemical analysis of zinc used for galvanizing:

Samples taken from the zinc ingot shall be chemically analyzed as per IS: 209. The purity of zinc shall not be less than 99.95%.

- b) Chemical analysis, mechanical hardness tests and magnetic particle inspection for malleable casting:

The chemical analysis, hardness tests and magnetic particle inspection for malleable casting will be as per the internationally recognized procedure for these tests. The sampling will be based on heat number and heat treatment batch

### Test during manufacture on all components as applicable on hardware fittings

- a) Chemical analysis of zinc used for galvanizing

Samples taken from the zinc ingot shall be chemically analyzed as per IS: 209. The purity of zinc shall not be less than 99.95%.

- b) Chemical analysis, mechanical hardness tests and magnetic particle inspection for malleable casting:

The chemical analysis, hardness tests and magnetic particle inspection for malleable casting will be as per the internationally recognized procedure for these tests. The sampling will be based on heat number and heat treatment batch

- c) Chemical analysis, mechanical hardness tests and magnetic particle inspection for fabricated hardware.

The chemical analysis, hardness tests and magnetic particle inspection for fabricated hardware will be as per the internationally recognized procedure for these tests. The sampling will be based on heat number and heat treatment batch.

- iii) The following, acceptance & routine tests and tests during manufacturing shall be carried out on the conductor.

### Acceptance Tests

a)	Visual check for joints, scratches etc. and length of conductor	
b)	Dimensional check on steel and Aluminum strands	
c)	Check for lay ratio of various layers	
d)	Galvanizing test on steel strands	

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e)	Torsion and Elongation test on steel strands	
f)	Breaking load test on steel and Aluminum strands	
g)	Wrap test on steel and Aluminum strands	IS: 398(Part-V) 1982 Clauses 12.5.2, 12.7 & 12.8
h)	DC resistance test on Aluminum strands	
i)	UTS test on welded joint of Aluminum strands	

**NOTE:** All the above tests except test mentioned at (i) shall be carried out on Aluminum and steel strands after stranding only

### Routine Tests

- a) Check to ensure that the joints are as per specification
- b) Check that there are no cuts, fins etc. on the strands
- iv) The following type, routine & acceptance tests and tests during manufacturing shall be carried out on the earth wire.

### Acceptance Tests

- a) Visual check for joints, scratches etc. and length of Earth wire
- b) Dimensional check
- c) Galvanizing test
- d) Lay length check
- e) Torsion test
- f) Elongation test
- g) Wrap test
- h) DC resistance test : IS: 398 (Part III) 1976
- i) Breaking load test
- j) Chemical Analysis of steel

### Routine Tests

- a) Check that there are no cuts, fins etc. on the strands.
- b) Check for correctness of stranding



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### **6.2 Type Test**

Test certificates for type tests shall be from CPRI/ERDA/NABL approved lab, as stipulated in Indian Standards carried out on similar equipment shall be furnished. If test certificate for any of the type test is not available, the same shall be carried out free of cost from CPRI/ERDA/NABL.

### **6.3 Test Witness**

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

### **6.4 Test Certificates**

- i) Certified copies of all tests carried out at works shall be furnished in requisite no. of copies as stated in the condition of contract for approval of the Owner. The certificates shall furnish complete identification, date including serial number of each material and accessory.
- ii) Equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.
- iii) Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

## **7.0 SPARES**

The Bidder shall submit a list of recommended spare parts for three (3) years of satisfactory and trouble free operation, indicating itemized price of each item of the spares.

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### 8.0 DRAWING & DOCUMENTS TO BE FURNISHED

#### 8.1 To be submitted with each copy of the Bid

- i) Typical general arrangement drawing of the equipment / items.
- ii) Technical leaflets on equipment / items expending constructional features.
- iii) Type test certificates on similar equipment / items.

#### 8.2 To be submitted for Approval and Distribution

- i) Dimensional general arrangement drawing showing disposition of various fittings for equipment, accessories, components etc.
- ii) Assembly drawing for erection at site with part numbers and schedule of materials.
- iii) Type & Routine test certificates
- iv) Technical leaflets on equipment / items
- v) Back-up calculation for:
  - a) Selection of equipment / material ratings.
  - b) Sag-Tension of ACSR.
  - c) Lighting protection system
  - d) Selection of rigid bus support spacing.
- vi) Any other relevant drawing, documents, calculations and data necessary for satisfactory installation, operation and maintenance.

### DESCRIPTION OF HARDWARE TO BE SUPPLIED UNDER THIS SPECIFICATION

SL. NO.	DESCRIPTION
1.0	66KV Tension String (Ball dia. 20mm)
a)	Double Tension String with double anchor, tension clamps suitable for Twin ZEBRA conductor.
b)	Double Tension String with double anchor, tension clamps suitable for Twin ZEBRA conductor.
c)	Double Tension String with double anchor, tension clamps suitable for Single ZEBRA conductor, with turnbuckle and metal parts
d)	Double Tension String with double anchor, tension clamps suitable for Single ZEBRA conductor.
2.0	66KV Suspension String (Ball dia 20mm)
a)	Single Suspension string including arching horn, drop clamp suitable for Single Zebra conductor (sub conductor spacing of 250mm), metal parts
b)	Single Suspension string including arching horn, drop clamp suitable for Twin Zebra conductor (sub conductor spacing of 250mm), metal parts
c)	Single Suspension string including arching horn, suspension clamp suitable for Single Zebra conductor (sub conductor spacing of 250mm), metal parts
d)	Single Suspension string including arching horn, suspension clamp suitable for Twin Zebra conductor (sub conductor spacing of 250mm), metal parts

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3.0	Bolted Type Clamp
a)	Tee connector Twin Zebra to Twin Zebra, Vertical take-off
b)	Tee connector Twin Zebra to Single Zebra
c)	Tee connector Single Zebra to Single Zebra.
d)	Parallel Groove clamp Single Zebra to Single Zebra
4.0	Flexible Spacer
a)	Suitable for Single Zebra with sub conductor spacing of 250mm
b)	Suitable for Twin Zebra with sub conductor spacing of 250mm
5.0	Shield Wire Tension clamp
6.0	Disc insulator Unit

Bidder to note that the above type of hardware is a minimum requirement and indicated for guidance only. Bidder shall estimate the quantity and types of hardware and offer and supply accordingly for successful operation of the installation.

### **9.0 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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**RATINGS & REQUIREMENTS**

<b>1.0</b>	<b>CONDUCTORS</b>	
<b>1.1</b>	<b>ACSR Conductor</b>	
1.1.1	Reference standard :	IS 398
1.1.2	Code Name :	ZEBRA
1.1.3	Type :	ACSR
1.1.4	Overall diameter	28.62mm
1.1.5	Stranding no. of wire and diameter :	54/3.18 (Al) 7/3.18 (St)
	Number of strands Core	1
	1st Layer	6
	2nd Layer	12
	3rd Layer	18
	4th Layer	24
1.1.6	Sectional area of Aluminum :	428.9 sq.mm
1.1.7	Total Sectional area :	484.5 sq.mm
1.1.9	Ultimate Strength (min) :	130.32 KN
1.1.10	Calculated DC resistance at 20 Deg C :	0.06868 ohm/Km

NOTE – The 66KV Main Bus Shall be with TWIN ZEBRA. The equipment bay shall be Single Zebra.

<b>2.0</b>	<b>GALVANISED STEEL SHIELD WIRE</b>	
2.1	Reference standard :	IS 398
2.2.	Number of strands	Steel core-1, outer Steel layer-6
2.3	Total sectional area	54.55 sq.mm
2.4	Overall diameter	9.45 mm
2.5	Approximate weight	428 kg/km
2.6	Calculated DC. resistance at 200C	3.37 ohms/km
2.7	Minimum ultimate tensile strength	56 KN
2.8	Direction of lay of outer layer	Right hand
2.9	Minimum tensile strength	110 Kgf/mm2
<b>3.0</b>	<b>CONNECTORS / PG CLAMP ASSEMBLY / SPACER</b>	
3.1	Reference standard :	
3.1.1	Clamp / Connector	IS 5561
3.1.2	Spacer	IS 10162
3.2	Material	Aluminum Alloy A6
3.3	Continuous current carrying capacity (r.m.s) at 50deg C ambient temp.	2000A (min)
3.4	Short time current carrying capacity	31.5KA for 3 sec
3.5	Maximum temperature rise over Ambient of 50	35 deg C

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	deg C	
4.0	<b>INSULATORS</b>	
4.1	Reference standard	
4.1.1	String Insulators/Insulator fittings	IS 731/ IS 2486
4.1.2	Post Insulators	IS 2544
4.2	Type	Post Insulator-
	Cylindrical solid	
	Core type,	
	Suspension &	
	Tension Insulator	
4.3	Service	Outdoor
4.4	System details	
4.4.1	Voltage	66/72.5KV (Nom/Max)
4.4.2	Nos. of phases	3
4.4.3	Frequency	50Hz
4.4.4	System neutral earthing	Effectively earthed
4.5	Insulation Level	
4.5.1	Dry power frequency withstand	140KV r.m.s
4.5.2	Wet power frequency withstands	140KV r.m.s
4.6	Impulse withstand	325KV
4.7	Creepage	31mm/KV

Bus Post Insulators shall have minimum cantilever strength of 800Kg and minimum torsion moment of 500 Kg.

### FITTINGS AND ACCESSORIES OF INSULATORS

Each insulator shall be furnished complete with the fittings and accessories as listed below according to requirement

1. Suspension top fitting
2. Suspension clamp fitting
3. Conductor suspension clamp
4. Tension end fitting
5. Tension (anchor) clamp adopter
6. Conductor tension (anchor) clamp
7. Top metal fitting
8. Bottom metal fitting
9. Nuts, Cotter pin, security clips etc.
10. Forged pin, studs etc.

Other standard accessories which are not specifically mentioned but usually provided with insulator of such type and rating for efficient and trouble free operation.

**TECHNICAL SPECIFICATION**  
**FOR**  
**BATTERY CHARGER**

Prepared by	Javed Ahmed		Rev: 0
Reviewed by	Abhinav Srivastava		Date:
Approved by	Vijay Panpalia		

## Chapter 6b. Technical Specification for Battery Charger

### 1.0 CODES & STANDARDS:

Material, equipment and methods used in the manufacture of battery charger shall confirm to the latest edition of following standard: -

Standard Name / No	Standard's Description
Indian Electricity Rules	Relevant safety regulation of CEA
Indian Electricity Act 2003	
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 1100 V
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

### 2.0 DOCUMENTS REQUIRED

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 loads
- iii. Approved vendor drawings
- iv. Other documents
- v. Battery Charger sizing calculation

## Chapter 6b. Technical Specification for Battery Charger

### 3.0 CHARGER DESIGN FEATURES:

The equipment shall have all the following features –

3.1	Configuration	As per calculation during detailed engineering with 2X100% Float cum Boost Charger.
3.2	Panel type	Metal enclosed frame construction
3.3	Location	Indoor, non air conditioned environment
3.4	Doors for front access	With anti theft hinge & handle
3.5	Cover for rear access	With Allen screw M6 size & handle
3.6	Construction	Sheet metal 2.0mm thick CRCA
3.7	Base frame	75mm ISMC
3.8	Lifting lugs	Four number
3.9	Gland plate	3mm metallic, un drilled & removable type
3.10	Enclosure protection	IP42 Minimum
3.11	Power terminal	Bus bar type, minimum 300mm above gland plate
3.12	Control terminal	Nylon66 with brass clamp
3.13	Bus bar	Tinned copper with insulation sleeve
3.14	Earth bus bar	Aluminum sized for rated fault duty for 1sec
3.15	Earth bus internal connection to all non current carrying metal parts	By copper flexible wire 2.5 sqmm
3.16	Earth bus external connection to owner earth	Al bus on both sides of panel with two holes for M10 bolt
3.17	Cooling	Natural ventilation without fan
3.18	Panel heater	Thermostatically controlled through MCB
3.19	Panel internal wiring	Multi strand flexible color coded PVC insulated copper wire 1.5 sqmm 1100volt grade with 1.5 sqmm ferruling (other than circuit wiring related to PCB cards )
3.20	Input isolation transformer	Dry type
3.21	Isolation & protection device	Mounted at height minimum 1000mm from bottom
3.21.1	MCCB	For charger input, output & battery input
3.21.2	Battery & test resistor load	Lockable change over switch with one position for charger, second for 'OFF' & third position for external test resistor.
3.22	Hardware (Nut, bolts & handle)	Stainless steel
3.23	Charger configuration	
3.23.1	Type	3 phase full wave full controlled semiconductor rectifier with heat sink
3.23.2	Pulse	Minimum six pulse



## Chapter 6b. Technical Specification for Battery Charger

3.23.3	Essential provision	Surge suppression, harmonic suppression, blocking diodes, filters for ripple control ,
3.23.4	Automatic phase sequence corrector	For 3 phase supply in right sequence, phase conversion. Protect equipment from phase reversal, phase loss.
3.23.5	Insulating shrouds	On all live parts, power semi conductors & electronic components
3.24	DC distribution board	If integral with charger, shall be given in separate compartment / shipping section
3.24.1	Outgoing feeder	Number & rating as per requirement. Each equipment shall have separate outgoing feeder.
3.24.2	Feeder type	All double pole MCB with insulating shrouds located inside panel
3.25	Ripple content in DC output	1% maximum
3.26	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%
3.27	Reverse polarity connection	Protected against reversed battery polarity
3.28	Charger efficiency	85% minimum
3.29	Noise output	65DB maximum
3.30	Charger selector switch	For auto/manual and float/boost selection, lockable type inside panel
3.31	Charging current settings	25% to 100% of rating
3.32	Charging current accuracy	2% of set current with input voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$
3.33	DC output adjustment range for float & boost charge (voltage & current)	By potentiometers inside panel, range suitable for NiCd as well as Lead Acid battery bank
3.34	Louvers	With stainless steel wire mesh
3.35	Gasket	Neoprene rubber
3.36	Panel illumination lamp with door switch	MCB controlled, with 5/15amp switch socket
3.37	Panel door keys	4 no. per panel, identical key for all panels
3.38	PCBs for electronic circuitry	With protective layer finish at back
3.38.1	PCB soldering	Preferably by wave soldering process
3.38.2	PCB/ electronic card mounting	With press fit type locking arrangement
3.39	Semiconductor component mounting	Shall not be on bakelite sheet

## Chapter 6b. Technical Specification for Battery Charger

### 4.0 METERING, ANNUNCIATIONINS & INDICATION:

4.1	Ammeter (96x96mm)	Digital type, for AC input, DC output & battery current
4.2	Voltmeter (96x96mm)	Digital type, with selector switch for AC input, DC output & battery voltage
4.3	LED indication on panel front	
4.3.1	Status	
4.3.1.1	Input AC supply available on R,Y & B phase	Red/yellow/blue color LED
4.3.1.2	Float cum Boost charger AC MCCB 'ON'	Red color LED for each charger module
4.3.1.3	Charger output DC 'ON'	Red color LED for each charger module
4.3.1.4	Outgoing DCDB feeder ON	Red color LED for each other
4.3.2	Fault	
4.3.2.1	DC earth fault	Amber color LED
4.3.2.2	Battery MCCB OFF	Amber color LED
4.3.2.3	Charger output DC under/ over voltage	Amber color LED
4.3.2.4	AC mains under	Amber color LED
4.4	Annunciation	Hooter with isolating switch for fault annunciation.
4.5	Potential free contacts for remote indication	Wired to terminal blocks
4.5.1		Battery on boost
4.5.2		DC bus under voltage
4.5.3		DC bus over voltage
4.5.4		DC bus earth fault
4.5.5		Battery MCCB trip/ OFF
4.5.6		Common charger trouble
4.6	Common charger trouble to include-	All the charger trouble conditions shall have a potential free contact wired to terminal block and annunciation in the form of separate annunciation or on display unit of common controller
4.6.1	Incoming AC under voltage	
4.6.2	Incoming AC over voltage	
4.6.3	Charger input MCCB trip/ OFF	

## Chapter 6b. Technical Specification for Battery Charger

4.6.4	Charger output MCCB trip/ OFF	
4.6.5	Charger Dc under voltage	
4.6.6	Charger Dc over voltage	
4.6.7	Charger rectifier fuse blown	
4.7	Communication	All the above alarm, analog signal etc shall be available at single port on modbus protocol for SCADA.

## 5.0 APPROVED MAKE & COMPONENTS

5.1	Switch	Siemens / L&T (Salzer)
5.2	HRC Fuse Links	GE/ Siemens/ L&T
5.3	Diodes & SCR	Hirect/USHA/IOR
5.4	Meters	AE/Rishabh
5.5	AC Contractors &O/L Relay	L&T/Siemens/Telemecanique/GE/ABB
5.6	Terminals	Connectwell/Elmex/Wago/Phoenix
5.7	Push buttons / Actuator	L&T/Siemens/Vaishno
5.8	MCCB	L&T/Siemens/ ABB/GE
5.9	MCB	Legrand/Hager/Schneider
5.10	Indicating lamps LED type	Vaishno/Binay/Teknic/Siemens/Mimic

Note – Any other make or component to be approved by owner.

## 6.0 DCDB FEEDER DETAILS:

DCDB shall be integral part of Battery charger and in scope of Vendor

S.No	Application	Type of Switchgear	Rating (A)	Quantity
1	Incomer	MCCB*	250	2
2	Battery Discharge feeder	MCCB*	250	1
3	DC emergency light	MCB*	40	2
4	ACDB	MCB*	40	1
5	66kV CRP	MCB*	40	8
6	11kV VCB	MCB*	40	15
7	Fire Alarm	MCB*	40	2
8	SAS	MCB*	40	2

**20% spare Feeders shall be provided each type in addition to above**

## Chapter 6b. Technical Specification for Battery Charger

### 7.0 MMIC DIAGRAM, LABEL & FINISH

6.1	Mimic diagram	To be provided
6.2	Name plate on panel front	
6.2.1	Material	Anodized Aluminum 16SWG
6.2.2	Background	SATIN SILVER
6.2.3	Letter, diagram & border	Black
6.2.4	Process	Etching
6.2.5	Name plate details	Manufacturer name, month & year of manufacture, equipment type ,input & output rating, Owner name & order number, guarantee period, weight of panel, degree of protection, Sr. No.
6.3	Labels for meters, indication & all cards / sub assemblies in panel	Anodized Aluminum with white character on black background
6.4	Danger plate on front & rear side	Anodized Aluminum with white letters on red background
6.5	Painting surface preparation	Shot blasting or chemical 7 tank process
6.6	Painting external finish	Powder coated polyester base grade A, shade – RAL 7032, uniform
6.7	Painting internal finish	Powder coated polyester base grade A, shade – white, uniform thickness 50 micron minimum
6.8	Labels for all components in panel	Anodized Aluminum with white character on black background, fixed by rivets only

### 8.0 INSPECTION & TESTING

7.1	Type test	Equipment 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.
7.2	Routine test	As per relevant Indian standard
7.3	Acceptance test	To be performed in presence of Owner at manufacturer works
		- Physical inspection & BOM, wiring check
		- Insulation resistance test
		- HV test for one minute
		- Voltage regulation test
		- Heat run test for 12 hours
		- Measurement of efficiency, power factor & ripple content

### 9.0 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**

**LITHIUM ION BATTERY**

Specification No-GN101-03-SP-118-00

Prepared by	Amar Deep Singh		Rev: 3
Reviewed by	Abhinav Srivastava		
Approved by	Sheshadri Krishnapura		Date:

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**Registered Office: BSES Bhavan, Nehru Place, Delhi - 110019**

**Revision Summary**

<b>S. No</b>	<b>Revision No</b>	<b>Item Clause</b>	<b>Nature of Change</b>	<b>Approved By</b>
1	R1	Clause no 6.1	Battery Size shall be Minimum 150AH	KS
2	R1	Clause no 6.18	Indications for ON/OFF and SOC	KS
3	R1	Clause no 6.19	Name Plate Details	KS
4	R1	Clause no 6.20	Equipment ID Painting	KS
5	R1	Clause No. 8	Packing and Delivery	KS
6	R2	Clause no 12	Variation in voltage levels	KS
7	R3	Clause No. 6.5.1	Li-ion chemistry – other available chemistry are also added	KS
8	R3	Clause No. 2	IEC and UL standards are added at S. No. 4, 5, 6 & 15	KS
9	R3	Clause No. 5.3	Nominal voltage changed from 50V to 48V as per industry norms	KS
10	R3	Clause No. 6.21	Safety Features – RoHS compliance is added	KS
11	R3	Clause No. 6.23	Battery Management System specification is added	KS
12	R3	Clause No. 6.5.1	Volumetric Energy Density parameter is removed	KS
13	R3	Clause No. 6.5.2	Gravimetric Energy Density parameter is removed	KS
14	R3	Para 12	Battery DoD is added in GTP	KS
15	R3	Para 12	Battery Cut-off is added in GTP	KS

**Index**

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## 1.0 SCOPE

This specification covers design, engineering, manufacture, assembly, stage testing, inspection & testing before supply, delivery at site and Erection Testing & Commissioning including SCADA communication of Li Ion Battery Bank.

## 2.0 CODES & STANDARDS

Material, equipment and methods used in the manufacturing of Li Ion battery shall confirm to the latest edition of following standard

Standard Name / No	Standard's Description
Indian Electricity Act	
CBIP manual	
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
IEC 62133, IEC 62620:2014,	Battery Safety
IEC 61960	Performance tests, Designations, markings, dimensions, and other requirements
IEC 61959	Tests and requirements for verifying the mechanical behavior.
IS 5	Paint and Enamels
IS 13703	LV Fuses
IS 5578	Guide for marking insulated conductors
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
IS 1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IEEE	Relevant Standard
UL 1642	Individual cell compliance
UL 1973	Battery module complies, test methods and requirements to ensure safety during transport other than for recycling or disposal
UL 2054	Household and commercial Batteries

## 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 DOCUMENTS REQUIRED

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 loads
- iii. Approved vendor drawings
- iv. Other documents
- v. Battery sizing calculation

#### 5.0 DC DISTRIBUTION SYSTEM DATA

5.1	DC Supply	2 wire, with positive & negative polarity
5.2	Earth reference	Unearthed system
5.3	Nominal Voltage	User Defined a) 220V DC b) 48VDC
5.4	Application - Industrial	Standby DC back up for switchgear control supply & SCADA RTU

#### 6.0 BATTERY BANK DESIGN FEATURES:

The equipment shall have all the following features –

6.1	DC battery bank Ah rating & sizing	150Ah (Minimum) battery bank at charging voltage of 220VDC/48VDC in CC-CV mode. Battery Shall be compatible with existing chargers i.e Dual Float cum Boost Charger
6.2	DC load curve	With High discharge characteristics. With 0.5C/ battery module
6.3	Location of battery bank	Indoor
6.4	Mounting of battery bank	On steel rack/cabinet with window glass, painted with anti corrosive paint.
6.5	Battery type	Li-ion Battery only
6.5.1	Li-ion cell chemistry	Different chemistry with material Manganese /Cobalt/iron/titanium etc subject to fulfillment of required parameters as mentioned in this specification.
6.5.2	Battery module round trip efficiency (%)	Min. 92

	Ingress protection	IP-55
6.6	Battery lifting/withdrawing arrangement	Suitable arrangement on Module
6.7	Battery Module designation	To be marked on cell as per relevant standard
6.8	Battery Module marking	Manufacturer name & type, month & year of manufacturer, nominal voltage, rated Ahr capacity & cell number
6.9	Battery terminals	As per Manufacturer standard
6.10	Terminal polarity marking	Positive & negative marked on Module
6.11	Insulating shrouds	For all battery terminals
6.12	Insulating pads for battery rack	Battery module to be 19 inch rack mounted, with supporting brackets on sides.
6.13	Battery suitable for Ripple content	5% minimum in DC charger output
6.14	Power terminal with insulator	Bus bar type mounted on rack suitable for 70sqmm cable
6.15	Cooling	As per Manufacturer standard
6.16	Communication	Modbus RS 485
6.17	Key parameters	Design capacity, full charge capacity, remaining capacity, state of charge, state of health, cycle count, total voltage, current, max cell voltage, min cell voltage, max cell temp, min cell temp, max FET temp.
6.18	Indications	LED Type i) Status type ii) SOC series of LED lights
6.19	Name Plate	
A	Material	Anodized Aluminum 16SWG
B	Background	SATIN SILVER
C	Letter, diagram & border	Black
D	Process	Etching
E	Name plate details	Manufacturer name, month & year of manufacture, equipment type, input & output rating, Owner name & order number, guarantee period, weight of panel, degree of protection, Sr. No.
6.20	Equipment ID Painting	Shall be given at the time of drawing approval. Following will be the features: 1) Equipment ID shall be painted on any appropriate face of the equipment at a clearly readable height from the base level of the equipment. 2) Font: Recommended type face for the signage is True type or Post script.

		<p>3) Font Size: All painting should be in UPPERCASE. Recommended height of 50 mm with spacing between alphabets of 3 mm.</p> <p>4) Total No's of Character: 18</p> <p>5) Height of Font: 50 mm</p> <p>6) Height of Base: 100 mm</p> <p>7) Spacing between alphabets: : 3 mm</p> <p>8) Paint: Base coat – Dense Yellow. Letters – Black Quick Drying paint 2 coats.</p>
6.21	Safety feature	<p>Internal fuse, protective terminal covering to avoid unintentional contact, secondary level hardware protection for overvoltage, heat propagation resistant cell holding structure, overvoltage protection, under voltage protection, over charging current protection, over discharge current protection, over temperature during discharge protection, over temp during charge protection. RoHS compliant – no use of certain hazardous in electric and electronic equipment</p>
6.22	Life Cycle	<p>Cycle life should be more than 4500 and should have no effect of high temperature storage.</p>
6.23	Battery management system	<ol style="list-style-type: none"> <li>Inbuilt battery data measurement and monitoring system</li> <li>All data should be available through mod bus RS 485 (for Monitoring in SCADA)</li> <li>Internal data logging for battery usage</li> <li>Battery SOH monitoring</li> <li>Display panel</li> <li>Self-protection and Diagnostic for over charge, over current, Module reverse polarity protection, fuse failure, over voltage, over discharge protection, over temperature during charge and discharge etc.</li> </ol>

## 7.0 INSPECTION & TESTING

6.1	Type test	<p>Equipment shall be of type tested quality as per Cl no. 2.0 for battery If the manufacturer's lab is accredited by govt. / authorized body then it shall be acceptable for type testing. For international standards, relevant certificate/test reports shall be acceptable.</p>
6.2	Routine test	<p>As per relevant standard mentioned in cl.no. 2.0</p>
6.3	Acceptance test	<p>To be performed in presence of Owner at manufacturer works and as per relevant std mentioned in cl. No. 2.0</p>

**8.0 PACKING AND DELIVERY**

Shall be packed such that protected against corrosion, dampness, heavy rains, breakage and vibration

**9.0 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.

**10.0 ACCESSORIES & SPARES**

Mandatory Spares shall be supplied along with Battery Bank.

**11.0 TRAINING**

Training on installation, commissioning, operation and maintenance of Battery Bank shall be at factory or at site after installation

## 12. GUARANTEED TECHNICAL PARTICULARS (DATA BY BIDDER)

S.NO.	Description	BRPL Requirement		Data to be filled by Manufacturer	
		48V	220V	48V	220V
1	Battery ( as per scope of supply) – Yes / No	Yes	Yes		
2	battery type	Li-Ion	Li-ion		
3	Type/Model No.				
4	Cell Chemistry				
5	Battery nominal voltage with variation upto $\pm 5\%$				
6	Total battery bank CC-CV charging required in volts	As per clause no 6.1	As per clause no 6.1		
7	Nominal Voltage of each Cell				
8	No of cells in each module				
9	No. of modules				
10	Input charge voltage				
11	Charge current				
12	Discharge current				
13	Battery DOD	90% minimum	90% minimum		
14	Life cycle with 90% DOD	4500 (minimum)	4500 (minimum)		
14	Battery efficiency (watt hour round trip)	>92%	>92%		
15	Service life	15 Years	15 Years		
16	Self discharge rate per month	0.1% @ 25°C	0.1% @ 25°C		
17	Cut off voltage	45V	210V		
18	Conformance to design standards as per specification clause no. 2.0 – Yes / No	Yes	Yes		
19	Conformance to design feature as per specification clause no. 5&6 – Yes / No	Yes	Yes		
20	Submitted of deviation sheet for each specification clause no - Yes / No	Furnish each deviation if yes	Furnish each deviation if yes		
21	Battery GA drawing submitted - Yes / No	Required	Required		
22	Battery selection / sizing calculation submitted – Yes / No	Required	Required		
23	Battery rating offered in	150Ahr	150Ahr		

	Ahr				
24	Rating at temperature 45 deg C	150Ahr	150Ahr		
25	Battery bank dimensions in mm ( length x depth x height)	As required	As required		
26	Battery Module weight in kg	As required	As required		
27	Heat generated by battery at rated full load (in Kw)	Less than 0.025kW/module	Less than 0.025kW/module		
28	Manufacturer of Li-Ion Battery Cells and Modules	Yes	Yes		
29	Manufacturer of Battery management system (BMS)	Yes	Yes		
30	Availability of Service team in India	Yes	Yes		
31	Built In Battery Management System	Yes	Yes		

**TECHNICAL SPECIFICATION**  
**FOR**  
**415V AC DISTRIBUTION BOARDS**

Prepared by	Supriya Raina	Rev: 0
Reviewed by	Abhinav Srivastava	Date: 25.11.2013
Approved by	Vijay Panpalia	

## **Volume-I Technical Specification for 415V AC Distribution Board**

### **1.0 415V AC DISTRIBUTION BOARDS:**

- 1.1 The AC distribution board shall be located in the Substation Building and shall be in two sections, each section fed by 415V, 3-phase supply from i) Station Aux Transformer ii) Shall be left for use in future. Each load center will be fed with separate outlet/ outgoing feeder. Auto changeover shall be provided between the two incomers with necessary interlocks.
- 1.2 The distribution boards shall be of modular construction with provision for complete compartmentalization of all feeders. It shall be free-standing, dead front type comprising dust-tight and vermin-proof sheet steel cabinets suitable for indoor installation with IP-54 degree of protection. The distribution boards shall be complete with necessary bus bar support insulators, cable glands, cable supports, terminal blocks, name-plates etc. All switches provided on the distribution board shall be on front side of the cabinets, operable from outside. The doors of cabinets shall be lockable. All instruments and control devices shall be mounted on the front of cabinets and fully wired to the terminal blocks. The board shall preferably be of the single front type, in fixed execution.
- 1.3 The various modules constituting the boards shall be provided with equipment/components such as switches, contactors, relays, control MCCB, ammeters, and voltmeters, terminal blocks etc. as required for complete circuit of the respective module.
- 1.4 The Boards shall be made out of at least 2.0 mm thick cold rolled steel sheet, suitably reinforced to provide flat level surfaces. Gland plate shall be 3.0mm thick. No welds, rivets, hinges or bolts shall be visible from outside. The doors shall be fitted with double lipped gaskets (subject to approval).
- 1.5 All cables shall enter and leave from bottom. Suitable cable terminal blocks with cable lugs shall be provided inside each cabinet for the incoming and outgoing cables. The terminals shall be serially numbered to facilitate installation and maintenance. Main busbars shall be accommodate in busbar chambers and cable alleys arranged by their side. Compression type cable glands shall be provided to hold the cables to avoid any pressure or tension on the terminal block connections. The terminal blocks shall be easily accessible for inspection and checking.
- 1.6 All the load break switches on the board shall be rotary type and shall be key operated.
- 1.7 The boards shall be given one primer coat followed by two finishing coats of epoxy based paint of light grey of Shade RAL 7032 with glossy finish.
- 1.8 The AC boards shall be provided with the following equipments wherever applicable:
  - i. Busbars of adequate rating.
  - ii. Terminal arrangement with necessary equipment for connecting the incoming supply.
  - iii. Module for voltage and current measurement in the incomer feeder.



## Volume-I Technical Specification for 415V AC Distribution Board

- iv. Outgoing modules with switch / MCCB units of adequate capacity for the outgoing feeders and 20% spare feeder units of each rating.
- v. Necessary cable glands and terminal blocks.
- vi. Adequate number of spare terminals on terminal blocks for receiving connections from the spare contacts of the relays and for external connections.
- vii. Multifunctional meter, voltmeter and ammeter.

1.9 The number of outgoing feeders from AC boards shall be such that each substation equipment is fed by separate feeder with 20% as spare(refer below table).

S.No	Application	Type of Switchgear	No of Poles	Rating (A)	Quantity
1	Incomer	MCCB*	4	630	2
2	Transformer Oil filtration	MCCB*	4	100	2
3	Power Socket( Indoor)	MCB*	4	63	1
4	Welding(Outdoor)	MCB*	2	63	4
5	Outdoor Lighting	MCB*	4	32	2
6	Indoor Lighting	MCB*	4	32	2
7	BMK	MCB*	4	32	8
8	Marshalling Box(PTR)	MCB*	4	32	3
9	Battery Charger	MCB*	4	32	2
10	AC Supply	MCB*	4	32	2
11	UPS	MCB*	2	16	1
12	11kV Switchgear	MCB*	2	16	3
13	CRP	MCB*	2	16	2
14	RTU/SCADA	MCB*	2	16	2
15	Fire Fighting	MCB*	2	16	1
16	EPAX	MCB*	2	16	1

\*Approved Make of MCCB/MCB:-Schneider/ABB/L&T

## 2.0 INSTRUMENTS

The indicating instruments shall be analog type square shaped and shall be flush mounting type. These shall have dust-proof and moisture- resistant enclosed cases. These shall be suitable for use in tropical climate. All AC instruments shall be connected through suitably rated current/voltage transformers.

## 3.0 BUSBARS

The busbars shall consist of tinned electrolytic copper of ample cross-sectional area, suitable for carrying their rated continuous current without their temperature exceeding 85 Deg.C. The busbars shall be continuous throughout each section.

## **Volume-I Technical Specification for 415V AC Distribution Board**

The busbars shall have current rating to suit the requirements corresponding to the loads incident thereon under the various operating conditions and shall withstand the applicable voltage and maximum short circuit stresses. The busbars shall be insulated from supporting structure by means of durable non-hygroscopic, non-combustible and non-tracking polyester fiberglass material or porcelain. Busbars shall be encased in heat-shrunk 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.

The busbars shall be housed in totally enclosed busbar chambers. The incoming connections from the busbar to the various feeders shall be so designed as not to disturb cable connections and to ensure safety to the operating and maintenance personnel and to facilitate working outside any outgoing module without the need for switching off in-feed to the adjacent modules, as far as possible.

A cable alley preferably 230 mm wide shall be provided in each vertical section for taking cables into the compartments.

### **4.0 CONTROL WIRING**

Each board shall be furnished completely factory wired upto terminal blocks ready for external connections.

All wires shall consist of 1100 V grade PVC insulated flexible stranded copper wires with a cross-section of 2.5 mm<sup>2</sup> (min.) suitable for switchboard wiring and complying with the requirements of the relevant IS. Each wire shall bear an identifying ferrule or tag at each end or connecting point.

Control cables for external connections shall consist of stranded copper wire with 1.5, 2.5, 4.0 sq.mm or higher cross-sectional areas and shall enter from bottom.

All interconnecting/outgoing control wiring shall terminate on stud type terminals on terminal blocks. The terminals shall be marked with identification numbers to facilitate connections.

The terminal blocks shall be made of moulded, non-inflammable, plastic material and arranged to provide maximum accessibility for inspection and maintenance.

The terminals shall be made of hard brass and have diameter of not less than 6 mm. The studs shall be securely locked within the mounting base to prevent turning. The terminal blocks shall be provided with twenty (20) percent spare terminals. The terminals shall be suitable for connections through crimped lugs.

### **5.0 INDICATING LAMPS**

Indicating lamps shall be of low wattage LED cluster type. The lamps shall be provided with translucent lamp covers which shall diffuse coloured light to give the specified indications. The lamp covers shall be unbreakable and moulded from heat-resistant fast coloured material. Necessary wiring shall be provided accordingly.

## **Volume-I Technical Specification for 415V AC Distribution Board**

### **6.0 INCOMER**

The ACDB shall have two incomer suitable as per station auxiliaries transformer rating. Each incomer shall have electrically operated MCCB of category B with automatic changeover arrangement. All outgoing shall be provided with MCCB/MCB of suitable rating. MCCB shall have over current and earth fault release.

### **7.0 NAME PLATES & MARKING**

Each panel shall be provided with legible and indelibly marked/ engraved name plates.

Name-plates of all the modules shall be white with black engraved letters.

On top of each module, name-plates with bold letters shall be provided for feeder designation. Each device shall also be suitably marked for identification inside the panels. Name- plates with full and clear inscriptions shall be provided inside the panels for all isolating switches, links, fuse blocks, test blocks and cable terminals. Every switch shall be provided with a nameplate giving its function clearly. Switches shall also have clear inscriptions for each position indication e.g. 'ON' 'OFF' etc.

### **8.0 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**

**GROUNDING & LIGHTNING PROTECTION  
SYSTEM**

Prepared by	Pronab Bairagi		Rev: 1	
Reviewed by	AS	Amit Tomar		Date: 27nd May, 2015
Approved by	VP			

## **Volume-I Technical Specification Grounding and Lightning Protection**

### **1.0 GROUNDING & LIGHTNING PROTECTION SYSTEM:**

#### **1.1 GROUNDING SYSTEM**

Earthing Installation shall be carried out as per IS 3043/IEEE 80-2000/IEC-517. The Station Earth mat shall be designed to meet required minimum area of cross section, current Density, Resistance, Touch & Step voltage criteria's mathematically before installation and shall be tested after installation to ensure the resistance of earth mats to be less than 0.5 Ohms. Bare Earthmat conductors (Strips/ Rods) to be installed below the ground as per safe designed to spacing in a grid pattern. Each junction of the grid shall be bonded by an electric arc welding process. Each bond has to be painted by Anti corrosive Paint (Bitumen). All ground wires installed in conduits shall be insulated. Bare ground conductors shall penetrate concrete through a PVC Sleeve. Equipment shall be generally being furnished with two separate ground pads with tapped holes, bolts, nuts & spring washers etc. Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each 100% capacity. Steel Columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one Earthing. Metallic Sheaths, Screens and armour of all multi core cables shall be earthed at both ends. Sheaths and armour of single core cables shall be earthed at switch gear end only

All ground wires installed in conduit shall be insulated. Bare ground wires shall penetrate concrete through a PVC sleeve.

Earthing of equipment shall generally be furnished with two separate ground pads with tapped holes, bolts, nuts and spring washers etc. Equipment ground connections, after being checked and tested shall be coated with anti-corrosive paint.

Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Steel columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing. Metallic sheaths, screens, and armour of all multi core cables shall be earthed at both ends. Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by Owner. Every alternate post of the metallic fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Rail for transformers within the plant area shall be bonded across fish plate and connected to earthing grid at several locations.

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.

Neutral points of transformer shall be solidly earthed by means of 2 Nos 75X10mm GI flat. Neutral Earth Electrode dimension shall be calculated by Long duration overloading of the

## **Volume-I Technical Specification Grounding and Lightning Protection**

Soil (i.e.) 40 A/sq.mtr as per IS 3043-1987 Clause 10.3.a Each earthing lead from the neutral of the Transformers shall be directly connected to two electrodes in treated earth pits which in turn shall be connected to station earthing grid.

Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.

Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections.

All ground conductor connections shall be made by electric arc welding and all equipment earth connections shall be made by bolting with the earthing pads through flexible insulated cable leads. Ground connections shall be made from nearest available station ground grid risers. Suitable earth risers approved by Engineer shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor

Resistance of the joint shall not be more than the resistance of the equivalent length of conductor. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound.

Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. 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.

Minimum earth coverage of 300mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Wherever earthing conductor crosses on runs at less than 300mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.

Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding/cleating at interval of 750mm.

Electrodes shall be embedded below permanent moisture level. Minimum spacing electrodes shall be decided by calculation referred in IEEE-80 based on soil resistivity value .If soil resistivity is poor and desired reduction in ground resistance is not achieved by adding more Grid Conductor Earth pits shall be treated with Permanent maintenance free artificial treatment compounds as per IEEE 80-2000 Clause14.5d.

On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at each termination shall be measured as per

## **Volume-I Technical Specification Grounding and Lightning Protection**

IEEE81-1983 (Wenner 3 point method). Earth resistance at earth terminations shall be measured in presence of Owner's representatives. Thickness of galvanizing shall be atleast 610gm/sq.m or 86 microns for all galvanized steel conductors.

- 1.2** The grounding/Earthing material shall be Terec++ or Marconite.
- 1.3** Earthing rods in RCC floor for GIS substation
- 1.4** Ground Electrode shall be 3M long MS rod of required size. These are to be fabricated and driven into the ground by the side of mat conductors. All connection to the conductors shall be done by arc welding process.
- 1.5** Risers are required for connecting the equipment and structures with the ground mat. These will be MS rod, laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free, at least 300 mm above ground level.
- 1.6** All steel Structures are required to be grounded at two points from ground mat. Laying supporting and connection at both end are within the scope of this specification.

All Earth Pits provided at the grid substation shall be interconnected with each other by MS Rod/Flat of adequate size as per symmetrical fault current.. The GI flat shall be buried in the earth at a minimum depth of 300 mm. Minimum ground coverage of 300mm shall be maintained between main earth grid and bottom of trench, tunnels, underground pipes other services / foundations. The earth grid conductor shall be run along the building column wall etc. with adequate and suitable supports at 750mm interval, if site conditions warrant so. The riser for equipment earthing shall be 75X10 mm GI flat. The orientation of these risers shall be such that minimum earthing strip is consumed for equipment earthing.

All the further joints / connection of GI Flat shall be arc welded.

- 1.7** 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.

The equipment connection with GI Flat shall be bolted connection. Each bolted connection shall be taken through two numbers bolts at each joint to ensure tightness and avoid loosening with passage of time.

In case the GI flat is to cross any obstruction, it shall be laid below the obstruction. At the crossing of building walls, floors etc the earth conductor shall pass through PVC conduit. Both ends of conduits shall be sealed after laying of conductor to prevent ingress of water.

Contractor shall use GI strip of following specification: - The GI flat will have minimum 610 gm/mm<sup>2</sup> Zinc coating and minimum 86 microns thickness. The galvanization provided shall be as per IS 2629. The galvanized surface shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surfaces of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, and unevenness of coating, spiky deposits, and blistered surfaces, flaking or peeling off.

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All hardware like bolts, nuts, spring and flat washers shall be galvanized; Stainless Steel or Zinc passivated shall be arranged by contractor.

1.7. Earthing Calculation parameters shall be taken as:

- 1) Duration of shock current in secs  $t_s=1\text{sec}$ .
- 2) Top Gravel resistivity shall be 3000 Ohm Meter.
- 3) Split Factor shall be considered as 1

### 2.0 EQUIPMENT EARTHING

All the equipment should be grounded with double run earth strip directly connected to earth mat at two different points.

- 2.1 The table provides the guidelines for Selection of Cross section of Earth conductor as per IEEE 80-2000 Clause 11.3.1 Equation 37 & Mild Steel as an Earth Conductor.

S. No	Fault current Level (KA)	Minimum Required Area of Cross Section (Sq.mm)
2.1.1	5	54
2.1.2	10	108
2.1.3	15	163
2.1.4	20	217
2.1.5	25	271
2.1.6	30	325
2.1.7	35	379
2.1.8	40	433

For various Equipments such as Power Transformer, Station Transformer, 11 KV Switch gear, 415V Panel, Light panel, Junction box, Street Lighting pole, Metallic fence, Isolator, Gantry tower & Electronic Earthing different cross sections of Earth conductor shall be selected as per the fault level. For switch gear rooms, a local earth conductor of adequate size of G.I flat may be run around the room below floor level to facilitate earthing of equipments in switchgear room.



## Volume-I Technical Specification Grounding and Lightning Protection

**2.2** However the table below provides general guidelines for selection of Earth Conductor for each Equipment

2.2.1	Description/location	Size
2.2.2	Earth mat	40 mm (min) to be selected by the contractor based on the calculations.
2.2.3	Power Transformer	100 X 8mm
2.2.4	Station transformer	50x6mm
2.2.5	11KV Switchgear	50x6mm
2.2.6	415V panel	50x6mm
2.2.7	Lighting panel	25x3 mm
2.2.8	Junction box	7/8 SWG
2.2.9	Street lighting pole	25x3 mm
2.2.10	Metallic fence	25x3 mm
2.2.11	Transformer yard fence and gate	50x6 GI flat with the help of flexible copper braid.
2.2.12	HV/LV/ LV Neutral cable box	50x6 GI flat
2.2.13	OLTC Drive mechanism body	25X3 GI flat
2.2.14	Battery charger panel	25X3 GI flat
2.2.15	DCDB	25X3 GI flat
2.2.16	Capacitor Bank Structure	50 X 6 GI flat
2.2.17	Capacitor unit and reactors	50 x 6 GI flat
2.2.18	Outdoor Circuit breaker, CT, PT & CVT	50 X 6
2.2.19	Secondary terminal Box of outdoor CT, PT & CVT	25 X 6 mm
2.2.20	Isolator Mechanism box, earth switch box	25 X 6 mm
2.2.21	Gantry tower and structure	75 X 10 mm
2.2.22	Electronic Earthing	Separate design and installation for all communication devices and electronic equipments including SCADA RTU, MOXA, Router/Switch. As per recommendation of SCADA vendor
2.2.23	Power Transformer Neutral earthing	75x10 sqmm

## **Volume-I Technical Specification Grounding and Lightning Protection**

The most stringent size of conductor among the two tables above shall be selected

- 2.3** For switchgear rooms, a local earth conductor of size 50x 6 mm GI flat may be run around the room below floor to facilitate earthing of equipments in switchgear room. This grid shall be connected to the main earth grid at minimum two points. Size of the conductor shall be selected considering the provisions in clause 2.1 and 2.2 above.
- 2.4** It is to be ensured that all the switchgears and transformers earth points/ connections are connected to earth grid and all the main and auxiliary earth grids are interconnected at minimum two points. With the above arrangement, the return path to the respective transformer neutral will have a predominantly metallic path. (i.e. Cable armour >>switchgear earth bus>>external earth flat>>earth grid>>transformer neutral.).
- 2.5** Where a 66 kV overhead line terminates at the substation, a metallic continuity between the end tower and the substation earth grid should be established with two independent connections.
- 2.6** The GI Flat shall be laid minimum 300 mm below the ground level but for the indoor location, it shall be embedded in the concrete floor; 50mm below the FFL.
- 2.7** The GI flat shall be welded after scratching off the galvanization locally and thorough cleaning of contact surface. After welding or bolting arrangement the joint shall be provided with anticorrosive Bitumen compound or zinc Phosphate paint. Wherever bolted connection is taken, it shall be taken through two bolts at each joint to ensure tightness and avoid loosening with passage of time.
- 2.8** Details of welding, bolting arrangement for various types of joints shall be as per Indian Standard.
- 2.9** Two separate and distinct earth connections shall be used for safety earthing of non-current carrying metallic enclosure of all equipments.
- 2.10** Two separate and distinct earth connections shall be used for earthing of Lightning / surge absorber.
- 2.11** Neutral bushing of oil/dry type Station transformer shall be connected to two independent earth pits by two no's separate GI strips.
- 2.12** Transformer yard fence, structures shall also be connected with the earth mat by 50X6 GI Flat with the help of flexible copper braid.
- 2.13** All damages to the galvanized finishes shall be made perfect with zinc rich or bitumen paint.

## **Volume-I Technical Specification Grounding and Lightning Protection**

- 2.14** RTU, marshalling box of SCADA or any other equipment installed in substation for SCADA shall not be connected to the earth grid, it shall be connected to separate two earth pits connected at two separate points of the panel.

### **3.0. LIGHTNING PROTECTION**

#### **DESIGN OF LIGHTNING PROTECTION**

- 3.1** Direct stroke lightning protection (DSLPP) shall be provided in the EHV switchyard by shield wires. The final arrangement shall be decided after approval of the DSLPP calculations. The Contractor is required to carry out the DSLPP calculations and submit the same to the Owner for approval of the same at detailed engineering stage after award of contract.
- 3.2** The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.
- 3.3** A 40 mm dia. 3000mm long MS earth electrode with test links, CI frame & Cover shall be provided to connect down conductor of towers with peak. The test joint shall be directly connected to the earthing system.
- 3.4** Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- 3.5** Down conductors used for lightning protection shall be cleated on the structures at 2000mm interval.
- 3.6** Connection between each down conductor and rod electrodes shall be made via test joint (pad type compression clamp) located approximately 150 mm aboveground level.
- 3.7** Lightning conductors shall not pass through or run inside G.I. conduits.
- 3.8** All metallic structures within a vicinity of 2000 mm in air and 5000mm below ground shall be bound to the conductors of lightning protection system.
- 3.9** In addition to Earth wires above the EHV switchyard, ESE Lightning conductor shall provides zone of Protection. Snapping of Earth wire does not make accidental situations during Lightning.

## **Volume-I Technical Specification Grounding and Lightning Protection**

- 3.10** This ESE Lightning Protection system requires an Air terminal, down conductor, Lightning Counter & an Earthing System. If the structure is more than 30m height then 2 no's of down conductor shall be used for side flashing. The Earthing system should not exceed more than 10Ω.
- 3.11** A 40mm dia M.S Earth Electrodes with Test Links, HDPE Cover shall be provided to connect down conductor. The test Link shall be directly connected to earthing system
- 3.12** Conductors of Lightning Protection system shall not be connected with conductors of Safety earthing system above ground level. Lightning Earth Pits shall be connected other earthing conductor below ground level by using Equipotential bonds which will not allow Surge current to flow from Lightning pits to other Earth pits
- 3.13** Connection between each down conductor & Test link shall be located approximately 2000mm above ground Level.
- 3.14** The Down conductor should be high conductivity bare copper tape with minimum size of 75 Sq.mm

### **3.15 Constructional Features**

#### **3.15.1 Galvanized Steel (Applicable for exposed G.S. flats)**

- a) Steel conductors shall be galvanized according to IS: 2629.
- b) The minimum weight of zinc coating shall be 610gm/sq. m. and minimum thickness shall be 86 microns.
- c) The galvanized surfaces shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surfaces of steel. The finished surface shall clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

### **3.16 Tests**

- 3.16.1** The Contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards. Contractor shall have to demonstrate all tests as per specification and equipment shall comply with all requirements of the specification.
- a) The galvanized steel shall be subjected to four one-minute dips in copper sulphate solution as per IS: 2633.
  - b) Zinc Coating thickness : As per IS: 4759
  - c) Uniformity of zinc coating : As per IS: 2633
  - d) Adhesion Test : As per IS: 2629
  - e) Mass of zinc coating : As per IS: 6745
  - f) Chemical Analysis: As per IS: 513 & IS: 1079

## **Volume-I Technical Specification Grounding and Lightning Protection**

3.16.2 The accessories for GSS Groundwire such as Tension Clamps, Copper braided wire etc. shall conform to & meet the test requirements of IS: 2121.

### **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**  
**LT POWER CABLE WITH FRLS OUTER SHEATH**  
**(Single & Multi-Core)**

**Specification no – SP-EWLP-01-R5**

Prepared By		Reviewed By		Approved By		Rev /Pa ges	Date
Name	Sign	Name	Sign	Name	Sign		
Rohit Patil		Amit Tomar		K. Sheshadri		R5/ 22	02.03.2020

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

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**TECHNICAL SPECIFICATION OF LT POWER CABLE**

**RECORD OF REVISION**

Sr. No.	Revision No.	Item/Cl. No.	Nature of Change	Approved By
1	R2	2.0	National & International Standards added	VP
2	R2	3.6 (c)	UV resistance test shall be carried out on all size of cable	VP
3	R2	6.4	Type tests Cl. Changed.	VP
4	R2	4.1 & 4.2	Cable Drum as per IS 10418	VP
5	R2	4.3	For 2C X 10 mm <sup>2</sup> cable drum length – 1000 +/- 5% Mtr	VP
6	R3	ANNEXTUE- C	New size cable added 1.1 kV 1CX1000 mm <sup>2</sup>	KS
7	R4	3.6	Drum number laser printing on every meter of cable outer sheath	KS
8	R5	2.0	National & International Standards added	KS
9	R5	3.6	FRLS outer sheath	KS
10	R5	3.9	FRLS outer sheath properties	KS
11	R5	6.5	Acceptance Test	KS
12	R5	Annexure-E	Sub vendor list	KS

**Prepared By**

**Reviewed By**

**Approved By**

**Rohit Patil**

**Amit Tomar**

**K. Sheshardri**



## 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 multi core 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

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		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.
2.23	IEC 1034	Measurement of smoke density of electric cables burning under defined conditions
2.24	ASTMD 2843 <b>(R5)</b>	Standard Test Method for density of Smoke from the burning or decomposition of cables
2.25	ASTM 2863 <b>(R5)</b>	Standard Test Method for measuring of minimum oxygen concentration
2.26	IEC 60754-1 <b>(R5)</b>	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

**TECHNICAL SPECIFICATION OF LT POWER 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><tr><th>S.no.</th><th>Shape</th><th>Single core</th><th>Multi core</th></tr><tr><td>1</td><td>Compacted Circular</td><td><ul style="list-style-type: none"><li>1cx300</li><li>1cx630</li><li>1cx1000</li></ul></td><td>2cx10</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>4x150</li></ul></td></tr></table>	S.no.	Shape	Single core	Multi core	1	Compacted Circular	<ul style="list-style-type: none"><li>1cx300</li><li>1cx630</li><li>1cx1000</li></ul>	2cx10	2	Sector	---	<ul style="list-style-type: none"><li>2cx25</li><li>4cx25</li><li>4cx50</li><li>4x150</li></ul>
S.no.	Shape	Single core	Multi core											
1	Compacted Circular	<ul style="list-style-type: none"><li>1cx300</li><li>1cx630</li><li>1cx1000</li></ul>	2cx10											
2	Sector	---	<ul style="list-style-type: none"><li>2cx25</li><li>4cx25</li><li>4cx50</li><li>4x150</li></ul>											
3.2	Insulation	Extruded XLPE as per IS : 7098 part-1												
3.3	Core Identification	As per Cl.10 of IS 7098 part-1												
3.4	Inner Sheath	For 1.1 kV 2CX10 , 2CX25 Pressurized Extruded For other cable Extruded Inner Sheath of 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) Not applicable for single core cables of size 300 , 500 , 630 & 1000 mm <sup>2</sup> d) Minimum area of coverage of armouring shall be 90% e) The breaking load of armour joint shall not be less than 95% of that armour wire / strip f) Zero negative tolerance for thickness of armour strip shall be as per IS:3975 g) Zinc rich paint shall be applied on strip/wire and its joint surface.												
3.6	Outer Sheath	a) Extruded FRLS ( <b>R5</b> )outer sheath of PVC (ST-2) shall be as per IS:5831 b) Colour : Yellow (For multi core cables)												

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		<p>Black (For single core 300,500, 630 &amp; 1000 mm<sup>2</sup>)</p> <p>c) FRLS(<b>R5</b>) 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 (<b>R5</b>) outer Sheath shall be embossed with following minimum text:</p> <ul 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) Manufacture name/Trade mark</li> <li>iv) Number of Cores and nominal cross section area of conductor</li> <li>v) Name of buyer i.e BRPL (BSES Rajdhani Power Ltd.)</li> <li>vi) Month &amp; year of manufacturing</li> <li>vii) IS reference , i.e. IS:7098</li> <li>viii) P.O No. and Date</li> <li>ix) Font size shall be 5/5mm</li> <li>x) ISI mark</li> </ul> <p>The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.</p> <p>Following points shall be laser printed on every meter of cable</p> <ul 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> </ul>
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 heat shrinkable HDPE caps
3.9	FRLS Properties ( <b>R5</b> )	<p>Oxygen Index : Not less than 29% as per ASTM 2863</p> <p>Temperature Index : 250 Deg C at Oxygen Index 21 (when tested as per ASTM D 2863)</p> <p>Max Acid Gas Generation – Not more than 20% as per IEC -60754-1</p> <p>Light Transmission - Minimum 40% when tested as per ASTM D 2843 (Smoke Density rating shall be max 60%)</p> <p>Flammability Test – As per IEC 60332-III, Cat – B, IEC 60332- I, IS- 10810 – Part 53, IS:10810 – Part 61 &amp; 62 (Category A)</p>

## 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.

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		(The drums shall be provided with M.S spindle plate and nut-bolts arrangement as per IS : 10418 )
4.3	Drum Length & Tolerance	For 1.1 KV 2C X 10 mm <sup>2</sup> Cable - 1000+/-5% Mtr For all size above 10 mm <sup>2</sup> Cables - 500 +/-5% Mtr
4.4	Overall Tolerance	-2 % for the total cable length for the entire order.
4.5	Short Length of Cable	a) Minimum Acceptance short length shall be 1% of the total ordered quantity and no length shall be less than 500 mtrs for 2C X 10 mm <sup>2</sup> cable & 250 mtr for all sizes above 10 mm <sup>2</sup> . Manufactures shall be taken prior approval from BRPL Engineering for any short length supply. Short length will be accepted in last lot. b) Manufacture shall not be allowed to put two cable pieces of different short length in same cable drum
4.6	Preventive Measure for cable Drum	a) The surface of the drum and outer most cable layer shall be covered with water proof layer b) Ferrous part of wooden drum shall be treated with suitable rust preventive paint/coating to minimize rusting during storage.
4.7	Drum Identification Labels	a) Drum identification number b) Cable voltage grade c) Cable code (eg. A2XFY/A2XWY) d) Number of cores and cross sectional area e) Cable quantity i.e cable length (Meters) f) Purchase order number, date & SAP item code g) Total weight of cable and drum (kg) h) Manufacture's and Buyer's name i) Month & year of manufacturing 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. k) Cable length final end-marking (i.e reading at the inner end and reading at the outer end, just before packing shall be marked on the drum.

## 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 ,

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

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	As per Annexure – E. In event of order Manufacturer has to Submit the signed copy of QAP.
6.2	Inspection hold points	AS per QAP
6.3	Routine Test	a) Measurement of Electrical Resistance b) HV test with power frequency AC voltage
6.4	Type Test	(a) Cables must be of type tested quality. Type test reports shall be submitted for the type, size and rating of cable offered along with bid. Type test shall not be more than 5 years old. In the event of type test being older than 5 years, bidder has to conduct the same at CPRI/ERDA, approved Lab without commercial implication to BRPL  (b) Bidder supplying cable to BRPL for the first time shall have to conduct type test, Chemical Composition & UV resistance test on sample randomly selected from lot in event of order from CPRI/ERDA.  (c) 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 after exposure of 21 days as per ASTM standard).
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)(R5)	a) For cable sizes up to 50 mm <sup>2</sup> – one sample for chemical composition and purity test of aluminium shall be conducted upto r 100km of ordered quantity and multiple thereof.  b) 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.  c) Chemical composition and purity test of aluminium shall be conducted from the lot offered to BRPL on each size involved in the purchase order. Test shall carried out at NABL accredited third party lab without any price implication to BRPL.

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		d) The sample will be selected either during acceptance test or after receipt of cable in BRPL Stores.
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 DRAWING, DATA & MANUALS

7.1	To be submitted along with bid	<p>The vendor has to submit:</p> <p>a) Cross section drawing of cable</p> <p>b) Completely filled GTP</p> <p>c) Type test certificates</p> <p>d) Complete cable catalogue and manual along with the bid</p> <p>e) Copy of BIS licence</p>
7.2	After award of contract	Within 7 days, the seller has to submit four sets of above mentioned drawings for buyer's approval along with the signed copy of QAP (Annexure – E).
7.3	Final As Built	6 sets hardcopy + One Soft copy of all documents including type test certificates

## 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	<p>To be submitted to purchaser once a month containing</p> <p>(i) Progress on material procurement</p>

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		(ii) Progress on fabrication (As applicable) (iii) Progress on assembly (As applicable) (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 constraints/forward path.
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## 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. BRPL will review the deviations and if BRPL is agreed with the deviation, seller has to take written confirmation from BRPL 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 BRPL 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, BRPL 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 BRPL



**TECHNICAL SPECIFICATION OF LT POWER CABLE**

## **10.0 TECHNICAL PARTICULARS**

- a. GTP - As per Annexure-B for Multi-core cables.
- b. GTP - As per Annexure-C for Single-core cables (300, 500, 630 & 1000 mm<sup>2</sup> cables).
- c. Armour Coverage Percentage – As per Annexure-D.
- d. Quality Assurance Plan – As per Annexure-E.
- e. List of sub-vendors for Raw Material – As per Annexure-F.

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

## 11.0 ANNEXURE – A

### SCOPE & PROJECT SPECIFICATION DETAILS

#### 1.0.0 Scope

1.0.0	Scope	Design, manufacture, testing & supply of L.T Power Cables.
2.0.0	Delivery Schedule	To be filled up as per purchase requisition.

#### 2.0.0 Document Submission

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	2 copies (Typical Drawings)	2 Copies	2 Copies + 1 soft copy in CD	See Clause 7.0 for details of required drawings
Calculations	2 Copies (Typical)	2 Copies		
Catalogues	1 Copy			
Type Test Report	2 Copies			Type test and sample routine test reports

**TECHNICAL SPECIFICATION OF LT POWER CABLE**
**12.0 ANNEXURE – B**
**GUARANTEED TECHNICAL PARTICULARS (Multi-core)**

(Standard Cable sizes are 2c x10, 2c x25, 4c x25, 4c x50, 4C X 95, 4c x150, 4cx300)

For each size /rating separate GTP need to be furnished

Sr. No.	Description	Buyer's Requirement	Seller's data
	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 E	
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**

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 E	
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)	.....	
9	Outer Sheath (FRLS)		
A	Material and Type	As per Cl. 3.6	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

B	Minimum Thickness	As per Table 8 of IS 7098 Part-1	
C	Colour	Yellow	
D	Embossing Details	As per Cl.3.6 (f)	
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	
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	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

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? Yes / No	
23	FRLS Properties <b>(R5)</b>	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	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**
**13.0 ANNEXTURE- C**

## GUARANTEED TECHNICAL PARTICULARS (Single Core)

 (Separate GTP needs to be furnished for 300, 500, 630 & 1000 mm<sup>2</sup> cables)

S.No.	Description	Buyer's Requirement	Seller's data
	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.2.1.1	
B	Size (mm <sup>2</sup> )	300 / 500 / 630 / 1000 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 E	
6	Insulation	As per Table 3 of IS 7098	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

		Part-1	
A	Insulation Material	As per Cl. 3.2	
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 E	
7	Inner Sheath	Not applicable	
8	Armour	Not applicable	
9	FRLS Outer Sheath <b>(R5)</b>		
A	Material and Type	As per Cl. 3.6	
B	Minimum Thickness	As per Table 8 of IS 7098 Part-1	
C	Colour	Black	
D	Embossing Details	As per Cl.3.6 (f)	
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		



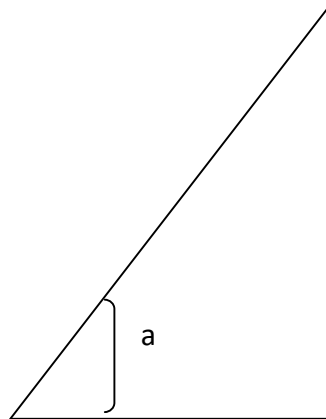
**TECHNICAL SPECIFICATION OF LT POWER CABLE**

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? Yes / No	
23	FRLS Properties (R5)		
	Oxygen Index	As per IS 1554, Part	
	Temperature Index	As per IS 1554, Part	
	Max Acid Gas Generation	As per IS 1554, Part	

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

	Light Transmission / Smoke Density	As per IS 1554, Part	
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**14.0 ANNEXTURE – D**  
**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%.

**TECHNICAL SPECIFICATION OF LT POWER CABLE**

**15.0 ANNEXTURE – E**

**LIST OF SUB-VENDORS**

For critical items

<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 <b>(R5)</b>	Kkalpana Industries Ltd. KLJ Polymers and Chemicals Ltd. Universal SCJ Plastic Sriram Polytech Shri Ram Vinyl, Kota
4	GI Strip <b>(R5)</b>	Tata Balaji Systematic Mica Wires Pvt Ltd. Bansal Industries




**SPECIFICATION  
OF  
FRLS CONTROL CABLE**

**Specification no: SP-EWLP-01-R3**

Prepared By		Reviewed By		Approved By		Rev. No.	Date
Name	Sign.	Name	Sign.	Name	Sign.		
HK		MB		KA		02	27.01.14
RP		AT		VP		03	13.03.18

**SPECIFICATION OF FRLS CONTROL CABLE****INDEX****RECORD OF REVISION**

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2. Annexure A: Scope & Project specific details.....	9
3. Annexure B: General Technical Particulars.....	10

 <b>BSES</b> BSES Rajdhani Power Ltd	SP-EWLP-01-R3
<b>SPECIFICATION OF FRLS CONTROL CABLE</b>	

### RECORD OF REVISION

Sr. No.	Revision No.	Item/Cl. No.	Nature of Change	Approved By
1	R3	2.1.7	FRLS Properties	VP

## SPECIFICATION OF FRLS CONTROL CABLE

### General Specification

1.0.0 Codes & Standards: The cables shall be designed, manufactured and tested in accordance with the following Indian & IEC standards.

#### National Standards

Indian Standards	
IS- 1554 Part-1	PVC insulated Cables
IS- 5831 : 1984	PVC insulation & sheath of electric cables.
IS- 10810 : 1984	Methods of test for cables.
IS- 8130 : 1984	Conductors for insulated electric cables and flexible cords.
IS- 3975 : 1999	Mild steel wires, formed wires and tapes for armouring of cables.

#### International Standards

IEC 60228 Ed.3.0 b	Conductors of insulated cables.
IEC 60332-3-21 Ed.1.0 b	Tests on electric cables under fire conditions. Part 3-21. Tests on bunched wires or cables.
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
IEC 60811	Common test methods for insulating and sheathing materials of electric cables.
IEC 60885 Ed.1.0 b	Electric test methods for electric cables.
IEC 60227	PVC insulated cables of rated voltages up to and including 450/750 V.
IEC 60028 Ed. 2.0 b	International Standard of Resistance for Copper
ASTMD 2843	Standard Test Method for density of Smoke from the burning or decomposition of cables
ASTM 2863	Standard Test Method for measuring of minimum oxygen concentration
IEC 60754-1	Test on gases evolved during combustion of materials fro cables. Part 1 – Determination of the Halogen Acid gas Content

2.0.0	Cable construction Features	Size & dimensions of each item mentioned under this clause shall be followed as detailed out in GTP, refer Annexure B


**SPECIFICATION OF FRLS CONTROL CABLE**


2.1.1	Conductor	
	Stranded, plain copper, circular	Shall be made from high conductivity copper rods
2.1.2	Insulation	Extruded PVC Insulation Type A as per IS 5831
2.1.3	Core Identification	Each core shall have different color of insulation.
2.1.4	Inner Sheath	Extruded Inner Sheath of Black PVC type ST-2 as per IS 5831
2.1.5	Armour	a) As per Cl 13.2 of IS 1554 Part-1: Galvanized steel round wire armour. b) Minimum area of coverage of armouring shall be 90 %.
2.1.6	Outer Sheath	a) Extruded outer sheath of PVC type ST-2 as per IS 5831 having FRLS properties b) Color : Black c) The Outer Sheath shall be embossed with: <ul style="list-style-type: none"> <li>➤ The voltage designation</li> <li>➤ Type of construction / cable code (for e.g. AYWY)</li> <li>➤ Manufacturers Name or Trade mark</li> <li>➤ Number of Cores and nominal cross sectional area of conductors</li> <li>➤ The drum progressive length of cable at every meter. (By Printing)</li> <li>➤ Name of buyer i.e. BSES</li> <li>➤ Month &amp; Year of Manufacturing</li> <li>➤ P.O. No. and P.O. Date</li> </ul>
2.1.7	FRLS Properties	a) Oxygen Index : Not less than 29% as per ASTM 2863 b) Temperature Index : 250 Deg C at Oxygen Index 21 (when tested as per ASTM D 2863) c) Max Acid Gas Generation – Not more than 20% as per IEC -60754-1 d) Light Transmission - Minimum 40% when tested as per ASTM D 2843 (Smoke Density rating shall be max 60%) e) Flammability Test – As per IEC 60332-III, Cat – B, IEC 60332- I, IS- 10810 – Part 53, IS:10810 – Part 61 & 62 (Category A)
2.1.7	Sealing of Cable end	Both ends of the cable shall be sealed with PVC Cap.



**SPECIFICATION OF FRLS CONTROL CABLE**

3.0.0	Testing & Inspection	Tests shall be carried out in accordance with IEC / IS standards.
		a) Routine Test: As per IS 1554 part -1
		b) Type Test
		<ul style="list-style-type: none"> <li>Cables must be of type tested quality. Type test reports shall be submitted for the type, size &amp; rating of cable offered along with bid.</li> </ul>
		<ul style="list-style-type: none"> <li>If the manufacturer's lab is accredited by govt. /authorised body then it shall be acceptable for type testing.</li> </ul>
		<ul style="list-style-type: none"> <li>Type test on one cable drum of each rating and type, from first lot, shall be conducted at Govt. approved / internationally accredited labs.</li> </ul>
		c) Acceptance test : Shall be conducted as per IS 1554 Part-1 for each lot of cable
		d) Inspection
		<ul style="list-style-type: none"> <li>The Buyer reserves the right to witness all tests specified on completed cables</li> </ul>
		<ul style="list-style-type: none"> <li>The Buyer reserves the right to inspect cables at the Sellers works at any time prior to dispatch, to prove compliance with the specifications.</li> </ul>
		<ul style="list-style-type: none"> <li>In-process and final inspection call intimation shall be given in advance to purchaser.</li> </ul>
		e) Test certificates: Three sets of complete test certificates (routine & acceptance tests) need to be submitted along with the delivery of cables.
4.0.0	Drawing, Data & Manuals	
4.0.1	To be submitted along with bid	<p>The seller has to submit:</p> <ul style="list-style-type: none"> <li>Cross section drawing of cable</li> <li>Completely filled GTP</li> <li>Type test certificates</li> <li>Complete cable catalogue and Manual along with the bid.</li> </ul>
4.0.2	After award of contract	Within 15 days, the seller has to submit four sets of above-mentioned drawings for buyer's approval.

 <b>BSES</b> BSES Rajdhani Power Ltd		<b>SP-EWLP-01-R3</b>
<b>SPECIFICATION OF FRLS CONTROL CABLE</b>		
4.0.3	Final As Built	6 sets hardcopy + One Soft copy of all documents including type test certificates
5.0.0	Drum Length & tolerance	500+ - 5% Mtr.
5.0.1	Overall tolerance in cable Length	- 2 %
5.0.2	Short length of cables	<ul style="list-style-type: none"> <li>Minimum acceptable short length shall be above 100 Mtrs. Manufacturer shall be required to take prior approval from engineering for any short length supply.</li> <li>Manufacturer shall not be allowed to put two cable pieces of different short lengths in same cable drum.</li> <li>Only 1% of the total ordered quantity.</li> </ul>
6.0.0	Packing, Shipping, Handling & Storage	
	a) Drum Identification Labels	
		<ul style="list-style-type: none"> <li>Drum identification number</li> <li>Cable voltage grade</li> <li>Cable code (e.g. YWY)</li> <li>Number of cores and cross sectional area</li> <li>Cable quantity (Meters)</li> <li>Purchase order number and SAP item code</li> <li>Total weight of cable and drum number</li> <li>Manufacturer's &amp; Buyer's name</li> <li>Month &amp; Year of Manufacturing</li> <li>Direction of rotation of drum</li> <li>Cable length initial reading &amp; 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.</li> </ul>
	b) Shipping information	The seller shall give complete shipping information concerning the weight, size of each package.
	c) Transit damage	The seller shall be held responsible for all transit damage due to improper packing.
	d) Type of Drum	Wooden drums with anti termite treatment. (The drums shall be with M.S. spindle plate with nut-bolts)
7.0.0	Quality Assurance	
7.0.1	Vendor quality plan	To be submitted for purchaser approval
7.0.2	Inspection points	To be mutually identified & agreed in quality plan
8.0.0	Progress reporting	

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<b>SPECIFICATION OF FRLS CONTROL CABLE</b>	

8.0.1	Outline Document	To be submitted for purchaser approval for outline of production, inspection, testing, inspection, packing, dispatch, documentation programme
8.0.2	Detailed Progress report	To be submitted to Purchaser once a month containing <ul style="list-style-type: none"> <li>• Progress on material procurement</li> <li>• Progress on fabrication (As applicable)</li> <li>• Progress on assembly (As applicable)</li> <li>• Progress on internal stage inspection</li> <li>• Reason for any delay in total programme</li> <li>• Details of test failures if any in manufacturing stages</li> <li>• Progress on final box up constraints / Forward path</li> </ul>
9.0.0	Deviation	<ul style="list-style-type: none"> <li>• Deviations from this specification are only acceptable where the Seller has listed in his quotation the requirements he cannot, or does not, wish to comply with and the Buyer has accepted, in writing, the deviations before the order is placed.</li> </ul>
		<ul style="list-style-type: none"> <li>• In the absence of a list of deviations, it will be assumed by the Buyer that the Seller complies fully with this specification.</li> </ul>

### Annexure – A

### Scope & Project Specific Details


#### 1.0.0 Scope

1.0.0	Scope	Design, manufacture, testing & supply of Control cables
2.0.0	Delivery Schedule	To be filled up as per purchase requisition.

#### 2.0.0 Document Submission

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	2 copies (Typical drgs)	2 copies	2 copies + 1 soft copy in CD	See Clause 5.0.0 for details of required drawings
Calculations	2 copies (Typical)	2 copies		

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<b>SPECIFICATION OF FRLS CONTROL CABLE</b>	

Catalogues	1 copy			
Type Test Report	2 copies			Type test and sample routine test reports

**TECHNICAL SPECIFICATION**  
**FOR**  
**ILLUMINATION SYSTEM**

Prepared by	Javed Ahmed		Rev: 0
Reviewed by	AK	AS	Date: 28th Mar, 2017
Approved by	VP		

## **Volume – I Technical Specification Illumination System**

### **1.0 ILLUMINATION OF SYSTEMS:**

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.

1.2 The minimum illumination levels shall be as specified below.

i)	Outdoor Substation	: 20 LUX
ii)	Roads within substation	: 20 LUX
iii)	Boundary wall of the substation	: 10 LUX
iv)	Control room	: 300 LUX
v)	Switchgear Room	: 200 LUX
vi)	Battery room	: 100 LUX
vii)	Stair case	: 100 LUX
viii)	Cable cellar ( for option A)	: 70 LUX
ix)	Near Substation gates	: 20 LUX

The illumination level of specific spots such as operating mechanisms of Capacitor bank isolator, oil level and temperature gauges of transformer etc. shall be minimum 100 Lux. Lux Level calculation to be done considering floor level as work plane height.

1.3 The bidder shall include in his offer light fittings of standard makes such as GE/Philips/Crompton/Bajaj or equivalent. Light fittings to be supplied by the bidder shall be subject to approval by the Owner.

1.4 Luminaries shall be flushed to ceiling

1.5 Complete design calculation sheets for arriving at the number and type of luminaries required for the normal and emergency requirements shall be furnished by the Contractor. Design calculation sheets for the selection of cables, MCB, HRC fuses, bus bars, etc. are also required to be furnished for Owner's approval.

1.6 The illumination system load and welding load in the substation area shall be supplied from 415/240 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

1.7 Each outgoing cable circuit for illumination and welding loads from the 415 volt switchboard shall terminate in the respective outdoor pillar boxes located in the substation. Outgoing feeders from the illumination and welding pillar-boxes shall be taken to the various illumination and welding load points in the substation Necessary fuses shall be provided near

## **Volume – I Technical Specification Illumination System**

light fixtures in the substation. 06 No's Welding socket shall be provided in the substation, out of which 4 no's shall be outdoor and two inside the control room building.

- 1.8 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.
- 1.9 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.
- 1.10 Dome lights shall be provided at gates.
- 1.11 Redundancy shall be provided wherever single luminary is considered.
- 1.12 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 authorized 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.
- 1.13 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. A total Of minimum 12 no's individually controllable 60 watt lamps shall be provided in the substation.

### **2.0 DISTRIBUTION PILLARS FOR NORMAL ILLUMINATION SYSTEM**

Distribution pillars of adequate dimensions shall be constructed from sheet steel having a thickness not less than 2 mm. 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. 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.

Each pillar shall accommodate the following

- i) One incoming, 4-pole (3 phase and neutral) isolating switch with cartridge fuses or MCB of appropriate current rating
  - ii) 3-phase and neutral bus bars of appropriate current rating
  - iii) Single-pole earth leakage circuit breakers of suitable current ratings on all outgoing circuits.
-

## **Volume – I Technical Specification Illumination System**

- iv) Neutral links for all outgoing circuits
- v) Cable lugs, compression type cable glands, name plates, circuit numbers, earthing lugs, etc. to make the pillar complete in all respects.
- vi) 20% spare outlets shall be provided for outgoing feeders.
- vii) Three (3) indicating lamps with fuses to indicate that supply is 'ON'.

Local junction boxes for emergency illumination in the substation shall be provided, as required

### **3.0 LIGHTING DISTRIBUTION BOARDS**

The Lighting Distribution Boards shall consist of the followings:

- i) 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.
- ii) 3-phase, 4-wire busbar system with high conductivity Aluminum 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.
- iii) The busbars shall be suitable for short-time current rating of 40KA for 1 Sec.
- iv) The busbar temperature rise shall not exceed 35 Deg.C over an ambient of 50 Deg.C.
- v) The degree of protection for the LDB shall be IP-54.
- vi) All cables shall enter from the bottom.
- vii) 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 energized.
- viii) 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.
- ix) 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.

### **4.0 MAIN EMERGENCY LIGHTING BOARD**

The Main Emergency Lighting Board shall consist of the following:

- i) Automatic changeover contactor
  - ii) Voltage sensing relays.
  - iii) Time delay relay.
  - iv) Bus Bars
  - v) Two pole/three pole rotary switches with HRC fuse for incoming and outgoing feeders
  - vi) Test switch, push button type.
  - vii) Indicating lamps, ac - Green, dc - Red.
  - viii) Terminals for remote indication.
-



## Volume – I Technical Specification Illumination System

- ix) 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.
- x) Change over DC lighting in case of black out.

The main emergency lighting board shall have an automatic changeover switch to energize 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 70 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.

Local Emergency Lighting Pillar shall be identical in details to Lighting Distribution Pillar specified in above para 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.

### 5.0 LUMINARIES

- 5.1 Luminaries for use in normal and emergency illumination systems in the substation are suggested below. In case the bidder intends to use luminaries of different types, he shall clearly furnish the advantages and reasons for the proposed luminaries in his bid. All the luminaries shall be supplied complete with all accessories and lamps

Sl. No.	Area / Type of Illumination System	Types of fitting & Lamps
1	Indoor	Fitting and fixtures suitable for LED Type lamps
2	Outdoor	Fitting and fixtures suitable for LED Type lamps
3	Roads	Fitting and fixtures suitable for LED Type lamps
4	Specific spots flood light	Fitting and fixtures suitable for LED Type lamps

- 5.2 The flood light luminaries 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 luminaries it shall be ensured that the stipulated electrical clearances are not violated. The Contractor shall supply and install suitable type of pole structures, required for installing the fittings for illuminating the roads, fence etc

## **Volume – I Technical Specification Illumination System**

### **6.0 WIRING**

All lighting fixtures and 5A convenience outlets shall be wired with 1.1 KV grade PVC insulated extra flexible, multi stranded, copper conductor cables of size not less than 2.5 sq.mm.

For 15A heavy-duty outlets copper conductor cables of size not less than 6 sq. mm shall be used.

The wiring shall consist of phase, neutral and ground. For grounding the lighting fixtures/convenience outlets etc., 2.5sqmm Green wire shall be used. The phase and neutral conductor shall be suitably colour coded.

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. While for stem-mounted/wall-mounted lighting fixtures the junction box shall be mounted below one of the mounting stems.

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.

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.

All wiring materials such as terminals, crimping lugs, ferrules etc. shall also be provided by the Contractor.

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.

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.

### **7.0 JUNCTION BOX / WALL BOX**

100 mm x 100 mm junction boxes and wall boxes of standard size shall be provided.

Wall boxes and junction boxes shall be made of sheet metal with a thickness of 14 gauge (minimum). Necessary conduit termination fittings such as bushings, locknuts etc. also be provided.

### **8.0 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.

**NEW GRID**

**TECHNICAL SPECIFICATION**

**FOR**

**SCADA INTERFACE WORK & AUTOMATION**

Prepared by	K A SENTIL KUMARAN		Rev: 7.2
Reviewed & Approved by	GOPAL NARIYA		Date: 08-01-2021

## **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 – BCU, BCPU & 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.
- 16 C x 1.5 mm<sup>2</sup>, multi stranded copper cable, ARM FRLS 1.1KV HRPVC, Application: digital signal feed back.
- 3P X 1.5 mm<sup>2</sup> for DO (Digital output)
- 2P X 0.5 mm<sup>2</sup> Screened GI Armored RS485, Twisted pair, 22 gauge Belden 8761 or equivalent for external (RTU to BCUs / MFM / BATT. CHG / Transformer Monitoring Devices) RS 485 connections.

The supplied cable shall be as a latest IS, also refer control cable specification.

### ❖ Cable Gland

## Chapter 6b. Technical Specification for SCADA interface work & Automation

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 the 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)

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 BCU,BCPU & Numerical Relays must have **dual redundancy communication ports** (Ethernet/Copper Ports) with **PRP & RSTP** protocols for SCADA connections & It will be connected to RTU via IEC 61850 protocol. (Dual Ports required to form **a Ring or PRP** Networks b/w relay to relay connections).

**Hot Standby/Dual Power Supply Unit** shall be supplied along with BCU. It will increase the BCU availability, if any one Power supply card fails the other one should keep the bay control unit continuous live.

## Chapter 6b. Technical Specification for SCADA interface work & Automation

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

For extending the signals from the grid to the Master Control Centre & Backup Control Centre, BCUs and RTUs are to be installed. BCUs 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 respective BCU or 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. BCUs can be of **ABB, Siemens, Schneider Electric, etc .**, make is depending on the type/ make of switch gears. **Remote Terminal Units need to be installed for interface between the BCUs and Control Centers (Main and Backup) through IEC – 60870 – 104 Protocol.** The

## Chapter 6b. Technical Specification for SCADA interface work & Automation

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 & BCU, 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, BCU 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 BCPUs, 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 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.

Data Base File must be downloadable and Uploadable from RTU, CPU and Gateway.

**Approved RTU makes – ABB-RTU560, Schneider-SAITEL DP and Siemens (AK3). Bidders who are OEM of RTU and Numerical Relays are only acceptable.**

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.

### 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 BCU, 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 without requiring software or database regeneration or License.

#### 2.6.2 Remote database, downloading of RTU from master station/SCADA control center.



## **Chapter 6b. Technical Specification for SCADA interface work & Automation**

- 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.
- 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 (or) 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.**
- 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.**
- 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
-

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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, it should 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 for housing the RTU modules/racks, relays 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 is created for communication equipments and Signal ground shall be connected to the communication equipment signal ground.

## 2.7 Ethernet /Fiber Switch

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The Ethernet/Fiber optic switches Should be a managed switch and are intended to be installed in the control room and shall be complaint 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.
- 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-3 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.
- Redundancy Ring : Dual Ring to be consider 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.

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- 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.
- 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.

### 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/BCU	Digital Out Put soft through N.Relay/BCU	Digital Input Hard Wire to RTU	Additional signals Hard wire to RTU for backup	Signal Type	N.Relay Protocol
Breaker ON	√			√	DPI	with Dual Communication Ports
Breaker OFF				√		
Trip Ckt Healthy -1 & 2	√				SPI	
Spring Charge	√				SPI	

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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	13 DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO			

Signals - 11KV Incomers	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 & 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	

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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	17 DI + Analog , Measurand Values	3 DO	2DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO			

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 & 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						

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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	14DI + 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/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	√			√		IEC-61850 with Dual Communication Ports
Breaker OFF				√	DPI	
Bank ISO ON	√					
Bank ISO OFF					DPI	
Trip Ckt Healthy -1 & 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	
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		√		√		
BKR Open COMMAND					DCO	
BANK ISO OPN		√				
BANK ISO CLS					DCO	
Master trip (86)reset from remote		√			SCO	
3Phase R,Y,B - Current&Voltage,Reactive Power,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). Disturbance Records, Fault Graphs for Remote diagnosis purpose	√				AI
Total Signals - BCPU & RTU	19 DI + Analog , Measurand Values	5 DO	2DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU,BCU	3 DI	2 DO			

Signals - 33 & 66KV Incomers/Out Going	Digital Input/AI soft through N.Relay/BCU	Digital Out Put soft through N.Relay/BCU	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				√	DPI	
Front Bus (89A) ISO ON(In-Case of O/D)	√				DPI	
Front Bus (89A) ISO OFF (In-Case of O/D)					DPI	
Rear Bus (89B) ISO ON (In-Case of O/D)	√				DPI	
Rear Bus (89B) ISO OFF (In-Case of O/D)					DPI	
LINE ISO (89L) ON (In-Case of O/D)	√				DPI	
LINE ISO (89L) OFF (In-Case of O/D)					DPI	
Earth Switch (89LE) -1 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) -1 OFF (In-Case of O/D)					DPI	
Earth Switch (89LE) - 2 ON (In-Case of O/D)	√				DPI	
Earth Switch (89LE) - 2 OFF (In-Case of O/D)					DPI	
Breaker in service (In-case of I/D BKR)	√				SPI	
Breaker in Test (In-case of I/D BKR)	√				SPI	
Trip coil Ckt Healthy - 1 & 2	√				SPI	
Spring Charge	√				SPI	
Master trip(86) Operated	√			√	SPI	
SF6 Pressure Low & SF6 Lock Out	√				SPI	
VT fuse Fail	√				SPI	
Panel DC Fail			√		SPI	
L/R Switch in Local	√				DPI	
L/R Switch in Remote	√			√	DPI	
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				√	DCO	
Front Bus (89A) ISO OPNCOMMAND (In-Case of O/D)		√			DCO	



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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 + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO		
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO				

Signals - 33 & 66KV Transformer	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
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	

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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
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 + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU,BCU	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	

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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,BCU	2 DI	1 DO			

Signals - 33 & 66KV BusCoupler	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
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	

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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
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 + Analog , Measurand Values	9 DO	2DI	5DI + 2 DO	
Essential inbuilt Spare in BCPU,BCU	6 DI	3 DO			

Signals - 33 & 66KV CAP Bank	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
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	

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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
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	5DI + 2 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	

## Chapter 6b. Technical Specification for SCADA interface work & Automation

BUS-A ISO CLS COMMAND						
BUS-B ISO OPN COMMAND		√			DCO	
BUS-B ISO CLS COMMAND						
Total Signals - BCPU & RTU	8 DI	4 DO				
Essential Spare in BCPU,BCU	2 DI	1 DO				

Signals - Smoke Detector - ALL Sensors,Manual Call Points Integration with RTU over MODBUS TCP/IP Protocol.	Soft Signals	Signal Type	Protocol
All Sensors Alarm operated Signals ( 10 to 20 Sensors)	√	SPI	MODBUS TCP/IP Protocol with Dual Communication Ports
All Manual Call Points - MCP-1,MCP-2.etc...	√	SPI	

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 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 /Insulation Fault	√		SPI	
Main Charger LT Supply Fail	√		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	

## Chapter 6b. Technical Specification for SCADA interface work & Automation

Charger B DC OUTPUT CURRENT	√		AI	
Charger B DC OUTPUT VOLTAGE	√		AI	
Battery Current	√		AI	
Battery Load Voltage	√		AI	
Battery Voltage from Transducer		√	AI	
Battery Current from Transducer		√	AI	<b>4 to 20 MA O/P</b>

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
R,Y,B Phase Current		√	AI

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
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
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	

## Chapter 6b. Technical Specification for SCADA interface work & Automation

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.

Note 2: SF6 Low/Lockout of all chamber signal to be wired up to RTU.

Note 3: PQA & Lithium Ion Signal will be finalized at the time of drawing review.

### 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 finalize 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 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.



## **Chapter 6b. Technical Specification for SCADA interface work & Automation**

- 3 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.
- 4 STATION BUS : Topology
  - Dual Homing (or) Redundant Ring with Ethernet/Copper Cable – From BCPU,BCU to Switch
  - Redundant Ring with Fiber Optic Cable – From Switch to RTU/Gateway.
  - Note : Dual Homing (or) Redundant Ring Network topology will be decided during the detail engineering stage.
- 5 The C & R ,RTCC,Battery Charger Panel should have additional spare contacts (potential free) for all SCADA signals – **Refer Signal List 2.8**
- 6 **Data Base File must be downloadable and Uploadable from RTU,CPU,BCPU,BCU and Gateway.**
- 7 **Separate Room/Cabinet With AC for RTU and IT Equipments.**
- 8 **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.**
- 9 **Training** should be provided on configuration, installation, commissioning aspects of RTU,DCU,BCU and Numerical Relay - BCPU at your training/work center to the BSES SCADA team (4 to 5 persons) & Training Expenses (Air & Local Travel, boarding and Lodging for 4 to 5 persons) at factory/training center(4 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.
- 10 **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
  - RTU Rack – 1 No
  - Communication Module for IEC-103 & Modbus Communications with Serial Interface Card/Memory in RTU – 1 No
  - DI/DO/AI/ Cards in RTU – 10% of the total IO signals
  - PSU Cards in RTU – 1 No
  - Fiber Optic Patch Cards with Connectors - 20% of total installed cables.
- 11 **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.

## **Chapter 6b. Technical Specification for SCADA interface work & Automation**

- 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.
- 12 Syatem Architecture : System Architecture should be submitted at the time of tendering process.
- 13 Drawings/GTP shall be submitted to BRPL-3 Sets hardcopy for approval in the event of award of work.
- 14 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.
- 15 DB back up along with Software in Pen drive shall be handover at the time of Handover of project for Final billing.
- 16 **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..

### **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 paln 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**

**CABLE INSTALLATION & ACCESSORIES**

Prepared by			Rev: 1
Reviewed by	Abhinav Srivastava		Date: 28.03.2017
Approved by	Vijay Panpalia		

## **Volume – I 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

## **Volume – I 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.

## **Volume – I 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.

## **Volume – I 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.
-

## **Volume – I 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.

### **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**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume-I 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) Air Handling 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
- 3.7 Air Conditioning shall maintain 22 Degree Celsius in summers and Winters, Environment condition shall be referred from General Design Criteria Chapter 1

## Volume-I Technical Specification Exhaust and Ventilation System

- 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 , Maintenance room and SCADA room. Exhaust system shall be supplied in following rooms -Toilet – one Pantry- One
Number and details of wall mounted/Ceiling fan	Battery room – 1 No Control room – 3 No's Switchgear Room – 6 No's <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.
	All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

## 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 DETECTION AND ALARM SYSTEM**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume – I 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.
- 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

This specification shall be read and constructed in conjunction with the bid documents and annexure to determine the scope of work.

## Volume – I Technical Specification Fire Detection and Alarm System

### 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.</li> </ol>
Location	Fire detectors shall be provided for the entire substation building including control room, switchgear room, battery charger, corridors etc in the ground floor only. 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 the cards become defective.</li> <li>2. The control panel shall be suitable for 230V AC and 220V DC as power supply.</li> </ol>
Cabling	<p>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)</p> <p>Cables for fire protection (smoke detectors etc.) shall run on cable tray along the wall.</p>
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	<p>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.</p> <p>Certify proper operation of all detectors and call points.</p>

## Volume – I Technical Specification Fire Detection and Alarm System

	One of each type of extinguisher shall be tested for its performance.
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### 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 EXTINGUISHER**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			



## **Volume-I 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 Nos. 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 (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.

## Volume-I 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

Prepared by	Renu Bala		Rev: 0
Checked by	Javed Ahmed		
Reviewed by	Abhinav Srivastava		
Approved by	Sheshadri Krishnapura		Date: 21 June 2018

## Chapter 6b

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- 14.0 Training

## Chapter 6b

**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

## Chapter 6b

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 FM200/NAF S 227 (HFC 227 ea) 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 FM200/NAF S 227 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.

## Chapter 6b

- 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.
- 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

## Chapter 6b

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  $\pi$  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  $\pi$  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



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**9.0. 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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**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.

## Chapter 6b

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**

Prepared by	Javed Ahmed		Rev: 0
Reviewed by	Abhinav Srivastava		
Approved by	Vijay Panpalia		Date: 28 <sup>th</sup> Mar 2017

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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. Automatic Iris
  3. Pan & tilt unit
  4. Receiver unit
  5. Weatherproof junction box
  6. Weatherproof housing for unit camera.
  7. Glass Dome with reflector shield on outside.
  8. Night Vision.
- 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
- 21" FULL HD, LED Monitor with HDMI interface to CPU with Keyboard, Optical Mouse for monitoring at Main Control Room & Security Gate.
- 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.

#### **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.

**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.



**Specification for  
Lighting High Mast  
Specification no – GN101-03-SP-33-00**

Prepared by		Reviewed by		Approved by		Rev No.	Date
Name	Sign	Name	Sign	Name	Sign		
Hemanshi		Abhinav Srivastava		Vijay Panpalia		00	04.01.2012

## 1.0 Scope of supply

This specification covers the requirement of design, manufacture and testing of 12M, 16M and 20M high mast along with accessories and requisite hardware. The scope also includes erection, installation and associated civil work like foundation etc.

## 2.0 Codes & Standards

All standards, specifications, and codes of practice referred to herein shall be the latest edition including all applicable official amendments and revisions as applicable.

IS: 5	1994	Colour for ready mixed paints and enamels.
IS:694	1990	PVC insulated cables for working voltages upto and including 1100V.
IS:800	1984	Code of practice for general construction in steel.
IS:802	1978 Part-2	Code of practice for use of structural steel in Overhead transmission line towers. Part-2 Fabrication, galvanising, inspection and packing.
IS: 875	1987 Part-3	Code of practice for design loads(other than earthquake) for buildings and structures: Wind loads
IS:2062	1992	Steel for general structural purposes.
IS: 2551	1982	Danger notice plates.
IS:2629	1985	Recommended practice for hot dip galvanising on iron and steel.
IS :2633	1986	Methods for testing uniformity of coating of zinc coated articles.
IS :3961	1967 Part-2	Recommended current ratings for PVC insulated cables. Part-2: PVC insulated and PVC sheathed heavy duty cables.
IS :5133	1969 Part-1	Boxes for enclosure of electrical accessories- Part-1: steel and cast iron boxes.
IS: 5831	1984	PVC insulation and sheath of electric cables.
IS :8130	1984	Conductors for insulated electric cables and flexible cords.
IS :10810	1984	Method of tests for cables.
IS:13703	1993 Part-1	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC .Part-1:General requirements
IS:13703	1993 Part-2	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC .Part-2:Supplementary requirements for fuses for industrial applications
BS EN 10-027 (part-1)	1992	Designation systems for steel: steel names, principal symbols
BS EN 10-027 (part-2)	1992	Designation systems for steel: steel numbers
BS 5135		National Electrical Code.
BS-EN 10-027		Indian Electricity rules(relevant safety regulation of CEA) and acts



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### 3.0 Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Maximum Ambient Temperature (Degree C)	50
Maximum temperature in shade (Degree C)	45
Min. Temperature of Air in Shade (Degree C)	-10
Relative Humidity (Percent)	10 To 100
Maximum annual rain fall (mm)	1450
Maximum Wind pressure (Kg/Sq. M.)	150
Maximum altitude above mean sea level (Meters)	3000
Isoceranin level (days per year)	50
Seismic level (Horizontal Acceleration) Moderately hot and humid tropical climate conducive to rust and fungus growth	0.3g

### 4.0 Technical Requirement

#### 4.1. Structure

The High mast shall be of continuously tapered, galvanised polygonal cross section, at least 20 sided, presenting a good and pleasing appearance, based on proven In-Tension design, conforming to the standards referred to above, to give an assured performance, and reliable service. The structure shall be suitable for wind loading as per IS - 875 Part -III, 1987.

#### 4.2. Construction

The mast shall be fabricated from special steel plates, conforming to BS-EN10-027, cut and folded to form a polygonal section and telescopically jointed and welded. The welding shall be in accordance with BS-5135. The sections are joined together by slip-stressed-fit method. No site welding shall be done. Only bolted joint shall be done on the mast at the site. The minimum over lap distance shall be 1.5 times the diameter at penetration. The dimensions of the mast shall be decided based on proper design and accordingly design calculations shall be submitted for review / approval.

The mast shall be provided with fully penetrated flange, free from any lamination or incursion. The welded connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with supplementary gussets between the bolt holes to ensure elimination of helical stress concentration. The entire fabricated mast shall be hot dip galvanised both internally and externally.

#### 4.3. Door Opening

An adequate door opening shall be provided at the base of the mast and the opening shall be such that it permits clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch. The door opening shall be complete with a close fitting, vandal resistant, weatherproof door, provided with a heavy-duty double internal lock with special paddle key.

#### 4.4. Dynamic Loading for the Mast

The mast structure shall designed as per TR No-7 of Institutions of lightning engineers of UK and shall be suitable to sustain maximum reaction arising from a wind speed as per IS-875 (three second gust), and is measured at a height of 10 meters above ground level.

#### 4.5. Lantern Carriage

A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fittings and control gear boxes. The lantern Carriage shall be of special design and shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by

grommets. (The lantern carriage tube should not be used as conduit. Separate flexible conduits are used from CG Boxes to the Flood Light Fixtures) The Lantern Carriage shall be designed and fabricated to hold the required number of flood light fittings and the control gear boxes, and also have a perfect self balance.

The Lantern Carriage shall be fabricated in two halves and joined by bolted flanges with stainless steel bolts and plastic lock type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The entire Lantern Carriage is hot dip galvanised after fabrication.

#### 4.6. Junction Box

The junction box shall be cast aluminium or SS, weather proof IP67 junction box. It shall be provided on the Carriage Assembly as required, from which the inter-connections to the designed number of the flood light luminaries and associated control gears fixed on the carriage, is made.

#### 4.7. Raising and lowering mechanism

It will be necessary to lower and raise the Lantern Carriage Assembly to install and maintain the luminaries and lamps. To enable this, a suitable Winch Arrangement shall be provided, with the winch fixed at the base of the mast and the specially designed head frame assembly at the top.

#### 4.8. Winch

The winch shall be of completely self-sustaining type, without the need for brake, shoe, springs or clutches. Each driving spindle of the winch is positively locked when not in use. Individual drum also should be operated for the fine adjustment of lantern carriage. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be clearly marked on each winch.

The gear ratio of the winch shall be 53 : 1 or as recommended by manufacturer. However, the minimum working load shall not be less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed manufacturers and details of the oil shall be furnished.

The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. The rope termination in the winch shall be such that distortion or twisting is eliminated and at least 5 to 6 turns of rope remains on the drum even when the

lantern carriage is fully lowered and rested on the rest pads. It should be possible to operate the winch manually by a suitable handle and/or by an external power tool. It would be possible to remove the double drum after dismantling, through the door opening provided at the base of the mast. Also, a winch gearbox for simultaneous and reversible operation of the double drum winch shall be provided as part of the contract.

The winch shall be type tested in a reputed test lab/ Institution and the test certificates shall be furnished before supply of materials. Test certificate shall be furnished by the bidder from the original equipment manufacturer, for each winch in support of the maximum load operated by the winch.

#### 4.9. Head Frame

The head frame, which is to be designed, as a capping unit of the mast, shall be of welded steel construction, galvanised both internally and externally after assembly. The top pulley shall be of appropriate diameter, large enough to accommodate the stainless steel wire ropes and the multi-core electric cable. The pulley block shall be made of corrosion resistant material, and is of the cast Aluminium Alloy (LM-6) or SS. Pulley made of synthetic materials such as Plastic or PVC is not acceptable. Self-lubricating bearings and stainless steel shaft shall be provided to facilitate smooth and maintenance free operation for a long period. The pulley assembly shall be fully protected by a canopy galvanised internally and externally.

Close fitting guides and sleeves shall be provided to ensure that the ropes and cables do not dislodge from their respective position in the grooves. The head frame shall be provided with guides and stops with PVC buffer for docking the lantern carriage.

#### 4.10 Stainless Steel Wire Ropes

The suspension system shall essentially be without any intermediate joint and shall consist of only non-corrodable stainless steel of AISI - 316 or better grade.

The stainless steel wire ropes shall be of 7/19 construction, the central core being of the same material. The overall diameter of the rope shall be more than 6 mm keeping in mind contingency. The breaking load of each rope shall not be less than 2350 kg. The design shall have a factor of safety over 5 for the system at full load. The end constructions of ropes to the winch drum shall be fitted with talurit.

The thimbles are secured on ropes by compression splices. Two continuous lengths of stainless steel wire ropes are used in the system and no intermediate joints are acceptable in view of the required safety. No intermediate joints, either bolted or else, shall be provided on the wire ropes between winch and lantern carriage.

#### 4.11 Electrical System, Cable and Cable Connections

A suitable terminal box shall be provided as part of the supply at the base compartment of the high mast for terminating the incoming cable. The electrical connections from the bottom to the top shall be made by special trailing cable. The cable is EPR insulated and PCP sheathed to get flexibility and endurance. Size of the cable is minimum 5 core 2.5 sq mm copper, in case of failure of any core 2 spare cores shall be available. The cable shall be of reputed make. At the top necessary weatherproof junction box to terminate the trailing cable shall be provided. Connections from the top junction box to the individual luminaries is made by using 3 core 1.5 sq mm flexible PVC cables of reputed make. The system shall have in built facilities for testing the luminaries while in lowered position.

Also, suitable provision shall be made at the base compartment of the mast to facilitate the operation of externally mounted, electrically operated power tool for raising and lowering of the lantern carriage assembly. The trailing cables of the lantern carriage rings shall be terminated by means of specially designed, metal clad, multi pin plug and socket provided in the base compartment to enable easy disconnection when required.

#### 4.12 Power Tool for the Winch

A suitable, high-powered, electrically driven, internally mounted power tool, with manual over ride, together with an operating stand shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The speed of the power tool may preferably of slow speed, of 1.5 to 1.8 m/minute, so that vibrations associated with high speed operation are avoided. The power tool shall be single speed, provided with a motor of the required rating, suitable for hand/stand operation. The power tool shall be supplied complete with push button type remote control switch, together with 6 (six) meters of power cable, so that the operations can be carried out from a safe distance of 5 (five) meters. The capacity and speed of the electric motor used in the power tool shall be suitable for the lifting of the design load installed on the lantern carriage.

The power tool stand shall be so designed that it will not only be self-supporting but also aligns the power tool perfectly with respect to the winch spindle during the operations. Also, a handle for the manual operation of the winches in case of problems with the electrically operated tool shall be provided and shall incorporate a torque-limiting device.

A separate torque-limiting device to protect the wire ropes from over stretching shall be provided. It shall be mechanical with suitable load adjusting device. The torque limiter is a requirement as per the relevant standards in view of the overall safety of the system.

#### 4.13 Lightning Finial

One number heavy-duty hot dip galvanised lightning finial shall be provided for each mast. The lightning finial shall be minimum 1.2 m in length and shall be provided at the centre of the head frame. It shall be bolted solidly to the head frame to get a direct conducting path to the earth through the mast. The lightning finial shall not be provided on the lantern carriage under any circumstances in view of safety of the system.

#### 4.14 Aviation Obstruction Lights:

Based on site and project specific requirements, 2 nos. Low Intensity Type-B (as per Table 6.3 of Volume-1, Annexure-14 of ICAO Guideline for Aerodrome Design & Operations) LED type aviation obstruction lights of reliable design and reputed manufacturer shall be provided on top of each mast.

#### 4.15 Earthing Terminals:

Suitable earth terminal pad using twin 12 mm diameter stainless steel bolts shall be provided at a convenient location on the base of the Mast, for lighting and electrical earthing of the mast.

#### 4.16 Luminaries:

The 250 W non-integral floodlight luminaries with LED lamps shall be provided with each mast. Optical compartment of the luminary shall be IP 66 and control gear compartment shall be IP 54 or better. Bajaj, Crompton and Philips make luminaries are approved. Detailed technical brochure shall be provided along with the bid.

#### 4.17 Feeder Pillar:

Feeder pillar required for feeding power to the Lighting mast shall also be supplied along with the mast and its accessories. The feeder pillar is fed from the main switchgear / main lighting distribution board. The outgoing of this feeder pillar are connected to the MCBs in the mast. The feeder pillar shall be FLP or WP IP 54 with rain protection canopy in galvanised CRCA sheet or cast Aluminium body (for FLP) and finished with two coats of epoxy primer and grey enamel paint of shade 631 of IS-5. The feeder Pillar shall comprise of incoming 32 Amp TPN switch, HRC fuses, outgoing 25 Amp SP MCB, Time switch and contactor for automatic on & off of circuit with manual override, TP MCB for power tool contactors for reversing the motor and overload Protection of motor. Feeder pillar shall be mounted on suitable foundation near to the mast.

## 5.0 Tests

All type test certificates for the tests listed in the relevant standards, conducted on identical masts shall be submitted to BSES for approval. Routine tests & acceptance tests as per relevant IS shall be conducted as per approved Quality Plan.

## 6.0 Marking / Name Plate

The high mast shall be provided with “BSES” insignia with anodized aluminium plate. Anodized plate showing 24X7 customer care number shall also be provided. Name plate shall include manufacturer name, date of manufacturing, warranty period and other details as per standards.

### Annexure A: Guaranteed Technical Parameters

Sl. No.	Particulars	Data by purchaser			Data by seller
1	Name and address of manufacturer				
2	Overall height of high mast	12 mtrs	16 mtrs	20 mtrs	
2.1	Make				
2.2	Material of construction of shaft	Grade S355 J O as per BSEN 10025 or equivalent			
2.2	Cross section of mast	20 sided, regular continuously tapered polygonal			
2.3	Number of sections	One	Two	Two	
2.3	Minimum thickness of shaft (mm)	4 mm	Bottom section: 5 mm Top section: 4mm	Bottom section: 5 mm Top section: 4mm	
2.4	Length of individual section (mm)	12000 mm	10900mm / 5850mm	10375mm / 10375mm	
2.5	Minimum Base and top diameter	340mm (A/F) and 150 mm (A/F)	450mm (A/F) and 150 mm (A/F)	500mm (A/F) and 150 mm (A/F)	
2.6	Type of joints	No site joints, mast should be delivered in a single section	Telescopic slip joint, stress fitted	Telescopic slip joint, stress fitted	
2.7	Length of overlap	N/A	750mm	750mm	
2.8	Metal protection treatment of fabricated mast section	Hot dip galvanization through single dipping process			
2.9	Thickness of	Minimum 85 microns as per IS:2629			

Sl. No.	Particulars	Data by purchaser			Data by seller
	galvanizations				
2.10	Size of opening door at base	Approx. 250 X 1200 mm			
2.11	Type of locking arrangement and door construction	Anti vandal type			
2.12	Details of struck board inside	Insulated base board			
2.13	Size , material and thickness of cable termination box				
2.14	Minimum size of base plate diameter	540 mm (min.)	650 mm (min.)	680 mm (min.)	
2.15	Minimum size of base plate thickness	25 mm thick			
2.16	Minimum size of anchor plate thickness	8 mm			
2.17	Details of template	Same as anchor plate but 2 mm thick			
<b>3</b>	<b>Dynamic loading as prevailing at site</b>				
3.1	maximum wind pressure (basic wind speed)	47m/s as per IS:875, p-3			
3.2	Maximum gust speed time	3 seconds			
3.3	Height above ground level at which wind speed is consider	10 mtrs			
3.4	Factor of safety for wind load	1.25			
3.5	Factor of safety for other load	1.15			
3.6	Application standard for mast design	Technical report #7:2000 by ILE, UK			
<b>4</b>	<b>Foundation details</b>				
4.1	Type of foundation	Open raft shallow footing or pile as applicable			
4.2	Size of foundation	as per design conforming to IS:456			
4.3	Design safety factor	2			
4.4	Considered wind speed	180 m /s			
4.5	Depth of foundation	As per requirement of design			
4.6	Average soil bearing capacity	As per site condition			
4.7	Numbers of foundation bolts	6 nos	8 nos		
4.8	PCD of foundation bolts	440 mm (min.)	550 mm (min.)	600 mm (min.)	
4.9	Type of foundation bolt	Tor steel			
4.10	Bolt diameter / length	25mm dia / 750 mm	32mm dia / 1325 mm	40mm dia / 1375 mm	
<b>5</b>	<b>Lantern Carriage</b>				



Sl. No.	Particulars	Data by purchaser			Data by seller
5.1	Diameter of Carriage Ring	Suitable to carry up to 4 nos. floodlights	1200 mm	1200 mm	
5.2	Construction	MS Channels / Tube, Hot dip galvanized	Channels 75X40X4mm thick	Channels 75X40X4mm thick	
5.3	Number of joints	As per manufacturer's standard design (2 segments as per CI no.4.5)	3 segments (2 segments as per CI no.4.5)	3 segments (2 segments as per CI no.4.5)	
5.4	Buffer arrangement between carriage and mast	Rubber padded guide ring provided			
5.5	Load carrying capacity	500 kg	750 kg	750 kg	
5.6	Total weight of assembly with fitting	as per design			
6	Winch				
6.1	Make of winch				
6.2	Number of drums/ winch	Double drum			
6.5	Gear Ratio				
6.3	Capacity	SWL 500 kg	SWL 750 kg		
6.4	Method of operation	Manual / power tool			
6.6	Operating speed				
6.7	Lubricant Arrangement	Permanent oil bath			
6.8	Type of lubricant				
6.9	Material of construction of gear	Phosphorus Bronze / EN 19			
6.10	Tested load per drum	500 kg	750 kg		
6.11	SWL of winch at 410 rpm	500 kg SWL	750 kg SWL		
7	Wire rope				
7.1	Make				
7.2	Grade	AISI 316			
7.3	Number of ropes	3 nos / 5mm (three wire rope)	3 nos / 6 mm (three wire rope)		
7.4	Construction	7./19			
7.5	Diameter of Wire rope	5mm	6mm		
7.6	Factor of safety	Not less than 5	Not less than 6		
7.7	Breaking capacity	Minimum 2350Kgs. X 2			
8	Cable				

Sl. No.	Particulars	Data by purchaser			Data by seller
8.1	Type	EPR coated PCP sheathed			
8.2	Material	Multicore copper conductor			
8.3	Make	Finolex, torrent, Polycab, KEI, Havells			
8.4	Current carrying capacity	As per IS 9968 (Part - 1), 1998			
8.5	conductor size	5CX2.5 sqmm.			
<b>9</b>	<b>Torque limiter</b>				
9.1	Lifting capacity	Upto 500 kg	Upto 750 kg		
9.2	Adjustable / non adjustable	Adjustable			
<b>10</b>	<b>Lantern and Fixture</b>				
10.1	Type Of Lamp	HPSV, Asymetrical IP65 fitting			
10.1.1	Wattage	400W			
10.1.2	Make				
10.1.3	Model Number				
10.2	Housing	Single piece gravity die-cast			
10.2.1	Material	Aluminium alloy: LM6			
10.2.2	Ingress protection				
10.2.3	For optical compartment	IP:65/IP:66			
10.2.4	For control gear compartment	IP:54 or better			
10.2.5	Dimensions of lantern	As per design standard			
10.2.6	Weight of lantern with control gear	As per design standard			
10.3	Lamp Cover	Perspex/Toughened glass			
10.3.1	Toughened glass				
10.3.2	Class of glass	AA/SSQ			
10.3.3	Nominal thickness	5mm			
10.3.4	Perspex thickness	2.5mm+/-0.4 mm			
10.4	Material of gasket	Slicon Rubber/ Neoprene			
10.5	Lamp holder	Screw type/three pin type			
10.5.1	Material	Porcelain			
10.6	Ballast	Conventional/Open type/ VI/VPI			
10.6.1	Ballast voltage	240V AC			
10.6.2	Minimum open circuit voltage	198V			
10.6.3	Frequency	50 Hz			
10.6.4	Current output(A), at rated voltage				
10.6.5	Voltage to current ratio ( ) +/-0.5%				
10.6.6	Watt loss ( W )	To be specified			
10.7	Power factor of lantern	More than 0.95 lag			
10.7.1	Value of capacitor	To be specified			
10.8	Igniter	Three wire			
10.9	Reflector	Anodised/POT			

Sl. No.	Particulars	Data by purchaser			Data by seller
10.9.1	Angle of tilt of lamp	To be specified			
10.9.2	Downward light output ratio	More than 70%			
10.9.3	Angle of throw	As per clause 5.12.5			
10.9.4	Angle of spread	As per clause 5.12.6			
10.9.5	Luminous intensity in C = 0° plane at $\gamma = 90^\circ$	Less than 10 Cd/klm			
10.9.6	Luminous intensity in C = 0° plane at $\gamma = 80^\circ$	Less than 30 Cd/klm			
10.10	Make of fixture	Bajaj, GE, Philips and CGL			
10.10.1	Nos of fixture provided with high mast	4	5	6	
10.10.2	Type of fixture	Weather proof			
<b>11</b>	<b>Others</b>				
11.1	Make of 24 hour Differential Timer Switch	Legrand/ GE/ Schnider/ L&T			
11.2	Make of 32A TPN MCB	GE/ Hager/ Legrand/ Schnider			
11.3	Make of 32A Contactor	L&T/ Schnider/ GE			
11.4	Earth pit	Two numbers of treated earth pit with each mast			
12	GTP and Drawing Submitted	Yes/No			
13	Type Tests Submitted	Yes/ No			
14	Technical Brochure of luminaries submitted	YES / NO			
15	Operation and maintenance manual submitted	YES / NO			

**TECHNICAL SPECIFICATION**  
**FOR**  
**PACKING & TRANSPORTATION**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume-I 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 loose 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 11KV & 66 KV panels etc. of MAP my india make (asset tracking system)

## **Volume-I 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**

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume-I 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



## **Volume-I 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**

## **Volume-I 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

Prepared by			Rev: 0
Reviewed by			Date:
Approved by			

## **Volume-I 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.
-

### **Volume-I 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.
-

## **Volume-I 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.

## **Volume-I 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:

## **Volume-I 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



## **Volume-I 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

**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**

<b>Standard Code</b>	<b>Standard Description</b>
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**

	<b>Description</b>	<b>Requirement / Rating</b>
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.

**Volume – I Technical Specification Post Insulator**

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</li></ul>

		<p>programme</p> <p>vi) Details of test failures if any in manufacturing stages</p> <p>vii) Progress on final box up constraints / Forward path</p>
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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> <p>i) Tentative GA /cross sectional drawing of product showing all the views / sections</p> <p>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</p> <p>iii) Completely filled GTP</p> <p>iv) Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.</p> <p>v) Details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification</p> <p>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.</p> <p>vii) Complete product catalogue and manual along with the bid.</p> <p>viii) Recommended spare parts and consumables items for 5 years of operation with prices and spare parts catalogue with list for future requirements.</p>
5.2.0	After award of contract, seller has	<p>i) Programme for production and</p>

## Volume – I Technical Specification Post Insulator

	to submit mentioned drawings for buyer's Approval (A ) / Reference (R)	testing (A) ii) Guaranteed Technical Particulars (A) iii) Calculations to substantiate choice of electrical , structural , mechanical component size / ratings (A) 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) v) Terminal arrangement & cable box details etc. (as applicable) (A) vi) Drawing for major components (A) vii) Rating & Diagram plate (A) viii) Detailed loading drawing to enable the buyer to design and construct foundations (as applicable ) (R) ix) Transport / Shipping dimensions with weights, wheel base details, untanking height etc. (As applicable ) (R) x) List of makes of all fittings and accessories (A) xi) Detailed installation and commissioning instructions ( R) xii) Quality plan
5.3.0	Submittals required prior to dispatch	i) Inspection and test reports, carried out in manufacturer's work (R ) ii) Test certificates of all bought out items iii) Operation and maintenance instruction as well as trouble shooting chart / manuals. iv)
5.4.0	Drawing and document size	Standard size paper A0, A1 , A2, A3, A4
5.5.0	No of drgs./Documents required at different 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

**Volume – I Technical Specification Post Insulator**

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	<p>To be performed in presence of Purchaser at manufacturer works:-</p> <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	<p>In each packing case, following details are required :</p> <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</li> </ul>

**Volume – I Technical Specification Post Insulator**

		<p>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. 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**



**Volume – I Technical Specification Post Insulator****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.

Sr. No.	Description	Scope of Supply
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-

Sr. No.	Purchaser Equipment Tag No. / SAP code	Location / Substation name	Unit	Quantity
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

	Along with offer	For Approval after award of contract	Final after approval	Remarks
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 –

Sr. No.	Description of spare part	Unit	Quality
1			
2			
3			
4			
5			
6			

# TECHNICAL SPECIFICATION

## SPARES-REQUIREMENT

Prepared by	Abhinav Srivastava		Rev: 1
Reviewed by	Vijay Panpalia		Date: 28.03.2017
Approved by	Vijay Panpalia		

## **Volume – I Technical Specification for Spares**

### **1.0 Spares Requirement:** Following Spares shall be supply shall be in scope of Vendor

1. Spare SF6 Gas cylinder 4 kg size-4 Nos
2. Cable/line Boot for 66 kV Side for each line with one set spare
3. Spare Relay for CRP Panels
  - a. O/C and E/F Relay- 2 Nos
  - b. Master Trip Relay- 2 Nos
  - c. Transformer Monitoring Relay (Eberle)- 1 No.
  - d. Differential Relay (with distance and line differential relay feature)- 1 No
  - e. Trip Circuit Supervision relay- 2 No.
  - f. Transformer Differential Relay- 1 No.
4. 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
5. Communication cable and Probes one of each type
6. Spare Media Converters (Optical to Digital) -1 No
7. 11 kV Board – Spares
  - a. Earthing Truck- 1 No for Each
  - b. CT and PT – 6 Nos each type
  - c. Allen Keys-2 Nos
  - d. Tool Kits-2 Nos
  - e. Discharge Rod suitable for 66kV- 2 Nos
  - f. PT Fuse HRC – 10 Nos
  - g. Vacuum Bottle for 2000A, 1250A and 800A breaker- 2 of each type
  - h. Terminal Jaws – 4 Nos
  - i. Test Terminal Block for Relays-4 Nos
8. Indication lamp for CRP and HT panel each colour- 10 Nos
9. TNC Switches- 2 Nos each type
10. Voltmeter- 2 Nos each type
11. Ammeter- 2 Nos Each type
12. Push buttons for CRP and HT panels- 5 Nos for each type
13. MCB – 2 Nos for each type in loose.

# **TECHNICAL SPECIFICATION**

## **GRID TRIVECTOR ENERGY METER**

Prepared by	Abhinav Srivastava		Rev: 1
Reviewed by	Vijay Panpalia		Date: 28.03.2017
Approved by	Vijay Panpalia		



**Volume – I Technical Specification for Grid Trivector Energy Meter**

**Grid Meter Technical Specifications -/1 Amp**

**ISI marked, class- 0.2S, three phase three wire, 4 quadrant, 110 Volts phase to phase, 1 Amp static (Electronic) trivector energy meter confirming to IS: 14697/1999, IEC: 62053-22 and CBIP report no 88, with latest amendment.**

**1. SCOPE:-**

This specification covers design, manufacturer, testing and supply of high precision three phase, 3 wire static trivector energy meter of accuracy class 0.2 S capable of performing functions of energy audit in EHV /sub transmission system.

**2. STANDARD APPLICABLE:**

The meters shall be of class 0.2 S class accuracy and shall meet all the requirements specified in standard specifications IS: 14697/1999.

**3. TECHNICAL REQUIREMENT & DESIGN CRITERION:**

- 3.1 Meters are required for installation at substations, The basic system parameters wherein these meters will; be installed shall be as under : -  
Secondary voltages : 110V Volts for 3 phase 3 wire  
Secondary current : 1 Amp
- 3.2 The meter shall be designed for 1 Amp. CT secondary and 200% overloading.
- 3.3 Accuracy -0.2S as per IS14697
- 3.4 The meters shall make use of non volatile memory for storage of billing and tamper data there shall be no battery back up for the retaining of data.
- 3.5 Computation of demand shall be on the basis of Real Time Clock of the meter itself.
- 3.6 Meters covered under this specification shall be fully static type with non volatile memory to register various billing parameters and complete with other features as detailed out in this specifications. Any other design meeting technical specification requirements or features / accuracy etc. better than this specification requirement manufactured as per relevant IEC /TS shall also be acceptable.
- 3.7 Meters shall be suitable for accurate measurement and display of energy and other billing parameters within the specified limits of errors under balanced and unbalanced loads conditions in a poly phase network.
- 3.8 POWER FACTOR RANGE : Meters shall be suitable for measurement of billing parameters with specified accuracy for full power factor range i.e. zero lag unity zero lead.
- 3.9 KVAh computation shall be on the basis of power factor lag + lead principle.
- 3.10 Multiplying factor for the CTs & PTs ratios shall be external.

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## Volume – I Technical Specification for Grid Trivector Energy Meter

- 3.11 The display of energy & also demand shall have minimum seven digits with fixed decimal. The energy and demand shall be displayed in KWh & KVA respectively.
- 3.12 The meter shall be fully programmable by the user for billing dates, MD resetting option etc.
- 3.13 Once finalised the meter constants shall be freezed and it shall not be possible by the manufacturer or the user to alter the meter constants at factory or at site.
- 3.14 Provision shall be made to read various billing parameters and also load survey data through a meter reading instrument, This arrangement can be through an optical coupler or any other suitable device galvanically isolated from meter circuit. Provision shall be made to seal the optical coupler to ensure proper security.
- 3.15 Meters shall be designed for satisfactory operation with the following supply voltage / frequency 50 Hz).
- Voltage – V. ref +20% to -30 %
- Frequency – 47.5 Hz to 52.5 Hz (ref. frequency 50 Hz)
- (For above voltage and frequency range the meters shall measure, register and display various parameters accurately).
- 3.16 **DISPLAY PARAMETERS:-**
- The data shall be displayed on LCD display which shall be clearly visible from distance in 7 segment 7 digit.
- The display parameters on Auto Scroll as well as Push Button shall be as per Annexure A
- 3.17 **Meter Reading at Power Outage :-**
- Provision to read the meter in No Power Condition shall be provided.
- 3.18. **MAXIMUM DEMAND REGISTRATION:-**
- Maximum demand computation shall be based on block interval concept with integration period of 15 minutes.
- 3.19 The MD integration cycle shall be on the basis of real time.
- 3.20. **TAMPER FEATURES:**
- Missing potential** – to indicate loss of potential in any or two phases of potential supply. The identification of phase date and time of first occurrence, date and time of last tamper restore and cumulative number of tampering shall be indicated.
-

## Volume – I Technical Specification for Grid Trivector Energy Meter

**Current unbalance** – to indicate there has been unbalance of current beyond the prescribed limits.

**Voltage unbalance** – to indicate there has been unbalance of Voltage beyond the prescribed limits

**CT Short / Open** : The meter shall be capable of detecting and recording occurrences and restoration of shorting (bypassing) / opening of any one or two phases of CT when the meter is connected to a 3 phase 4 wire system.

Snapshots (numerical values) of voltage, current, power factor and active import & apparent energy readings as well as the date and time of logging of the occurrence and restoration of all tamper events, subject to meter-memory space as described herein under, should be logged in the meter-memory and available for retrieving through the meter's optical port via MRI and downloading to the BCS.

Minimum 100 events ( occurrence and restoration where occurrence and restoration shall be counted as separate events) of all tampers with date and time shall be available in the meter memory on first-in, first-out basis.

The values for voltage, current and P.F. etc. for the purpose of logging occurrence and restoration of various types of tamper shall be mentioned.

Properly designed meter tamper logic should be provided. The tamper logic should be capable of discriminating the system abnormalities from source side and load side and it should not log/record tamper due to source side abnormalities.

Logics for design of above indicated tamper the value of voltage current time etc to be selected for design of tamper logics shall be in consultation with the purchaser,

- 3.21 Auto reset date of MD shall be indicated at the time of finalizing GTP. Provision should be made for automatic reset of max demand at the end of pre-defined period even after installation of meter at site.

- 3.22 Load Survey capability:-

It should be possible to store previous data of **38** days for interval of 15 minutes for parameters as per **and snapshots of energies at 24.00hours** as per **Annexure B**

- 3.23 It should be possible to down load view parameters, daily midnight readings and load survey data on the compatible computer and obtain full details of demand and consumption

- 3.24 Meters shall be four quadrant meters capable of recording active reactive and apparent energy and also demand in all the four quadrants.

- 3.25 **COMMUNICATION:** -For the output ports available in the meter standard communication interface shall only be adopted. The Meters shall conform to either open protocol standard IEC-62056 duly certified by the CPRI/ Modbus protocol or the meter should be API compliant duly certified by competent authority. In case

## Volume – I Technical Specification for Grid Trivector Energy Meter

any proprietary protocol is used in the meter, it will be obligatory on the part of the bidders to furnish complete details of proprietary protocol to the purchasers so that there may not be any difficulty in extraction of data from the meter through the available ports when connected to the communication bus (prepared for some other data communication purpose). Details of protocol used are necessarily required to be intimated/ furnished by the supplier to the purchaser. **The supplier shall integrate the meter with the existing communication system and set-up used in BRPL. The supplier has to provide an Undertaking in this regard.**

The energy meter shall have a galvanically isolated optical communication port, so that it can be easily connected to hand held common meter reading instrument for data transfer to or from meter reading instrument with proper security and without error and a hardwired port with RS232 port so that meter is subsequently hooked to a remote metering device such as GSM modem CDMA Modem, PSTN Modem etc and a mandatory RS485 port for to connect meters through daisy chaining. The optical port shall be located in front of the meter and shall have adequate sealing arrangement to seal it. Serial communication protocol shall be adopted for data communication. Meters covered under this tender will be employed for metering at or sub stations. In this case the instantaneous parameters load survey data and tamper information etc will be monitored remotely through computer installed in central station. The data from meter will be transferred to the central station through the either GSM / CDMA / PSTN/ Fiber communication links as meter are required to be completed with capability of remote meter reading.

It shall be possible to download the parameters as per **Annexure C** from Remote location at a frequency of 15 minutes

- 3.26 Output device : The meters shall have a test out put in the form of a blinking of LED for testing of the meters accuracy. Testing shall also be possible through optical port accessible from the front and can be monitored with meter reading instrument having high resolution display. The meters shall give high resolution energy values directly to meter reading instruments. The resolution will be sufficient to enable conduction of the starting current and accuracy test in less time.
- 3.27 Meter shall operate and record satisfactorily independent of phase sequence of input supply so long as phase association between voltage and current circuit is in order.
- 3.28 The performance of meter should not be affected by the external electromagnetic interference such as Electricals discharge of cable and capacitor, harmonics, electrostatic discharges, external magnetic field and injection of DC current in AC circuits etc.
- 3.29 The basic meter shall be designed for overloading up to 200%.
- 3.30 No setting point/ setting register etc, shall be provided for adjustment of measurement errors.

## 4. CONSTRUCTION OF THE METER:-

## Volume – I Technical Specification for Grid Trivector Energy Meter

Body of the meter shall be designed suitable for projection mounting. The meter should be made of high quality raw material to ensure higher reliability and longer life. The meter should be compact and reliable in design. e.g. to transport and immune to vibration and shocks involved in transportation / handling. The construction of the meter shall be suitable for this purpose in all respects and shall given assurance of stable and consistent performance under all conditions especially during dust storm / heavy rains / very hot days. All insulating material used in the construction of the meter shall be non hygroscopic non ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion. The construction of the meter shall be such as to be sealed independently and prevent unauthorized tampering. The meter cover should be ultrasonically welded with the base.

### 5. COMPONENT SPECIFICATIONS

Ser No	Component Function	Requirement	Makes and Origin
5.1	Current Transformers	The Meters should be with the current transformers as measuring elements. The current transformer should withstand for the clauses under 5.2.h	The current transformer should withstand for the clauses under 5.2.h
5.2	Measurement or computing chips	The Measurement or computing chips used in the Meter should be with the Surface mount type along with the ASICs.	USA: Analog Devices, Cyrus Logic, Atmel, Phillips, Texas Instruments. South Africa: SAMES Japan: NEC
5.3	Memory chips	The memory chips should not be affected by the external parameters like sparking, high voltage spikes or electrostatic discharges.	USA: Atmel, National Semiconductors, Texas Instruments, Phillips, ST, Microchip Japan: Hitachi or Oki
5.4	Display modules	a) The display modules should be well protected from the external UV radiations.  b) The display visibility should be sufficient to read the Meter mounted at height of 0.5 meter as well as at the height of 2 meters (refer 3.2.d for Viewing angle).  c) The construction of the modules should be such that the displayed quantity should not disturbed with the life of display (PIN Type).  d) It should be trans-reflective HTN or	Hongkong: Genda Singapore: Bonafied Technologies Korea: Advantek China: Sucess Japan: Hitachi, Sony Holland / Korea: Phillips

## Volume – I Technical Specification for Grid Trivector Energy Meter

Ser No	Component Function	Requirement	Makes and Origin
		STN type industrial grade with extended temperature range.	
5.5	Communication modules	Communication modules should be compatible for the two RS 232 ports (one for optical port for communication with Meter reading instruments & the other - for the hardwired RS 232 port to communicate with various modems for AMR)	<u>USA:</u> National Semiconductors, HP, Optonica, ST, Holland / Korea: Phillips <u>Japan:</u> Hitachi <u>Taiwan:</u> Ligitek <u>Germany:</u> Siemens
5.6	Optical port	Optical port should be used to transfer the meter data to meter reading instrument. The mechanical construction of the port should be such to facilitate the data transfer easily.	<u>USA:</u> National Semiconductors, HP <u>Holland / Korea:</u> Phillips <u>Japan:</u> Hitachi, <u>Taiwan:</u> Ligitek
5.7	Power Supply	The power supply should be with the capabilities as per the relevant standards. The power supply unit of the meter should not be affected in case the maximum voltage of the system appears to the terminals due to faults or due to wrong connections.	SMPS Type  (It should take care of clause 3.1 and 3.5)
5.8	Electronic components	The active & passive components should be of the surface mount type & are to be handled & soldered by the state of art assembly processes.	<u>USA:</u> National Semiconductors, Atmel, Phillips, Texas Instruments, ST, Onsemi <u>Japan:</u> Hitachi, Oki, AVX or Ricoh <u>Korea:</u> Samsung
5.9	Mechanical parts	a) The internal electrical components should be of electrolytic copper & should be protected from corrosion, rust etc.  b) The other mechanical components should be protected from rust, corrosion etc. by suitable plating/painting methods.	
5.10	Battery	Lithium with guaranteed life of 15 years	Varta, Tedirun, Sanyo or National
5.11	RTC & Micro controller	The accuracy of RTC shall be as per relevant IEC / IS standards	USA: Philips, Dallas Atmel, Motorola, Microchip Japan: NEC or Oki
5.12	P.C.B.	Glass Epoxy, fire resistance grade FR4, with minimum thickness 1.6 mm	

### 6. SEALING OF THE METER:-

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Proper sealing arrangements shall be provided on the meter to make it tamper proof and avoid mishandling by unauthorized person. Atleast two (2) seals on the body, two (2) seal on the terminals blocks and one seal each on communication ports could be provided. All the seals shall be provided on the front side only.

The meter body cover should be ultrasonically welded with the base such that it would not be opened without breaking / damaging the meter body.

### **7. CONNECTION DIAGRAM AND TERMINAL MARKING:**

The connection diagram of the meter shall be clearly shown on inside portion of terminal cover and shall be of permanent nature, Meter terminals shall also be marked and this marking should appear in the above diagram. The holes for lead sealing wire may be 2 mm, one hole should be provided in the head and one in the thread to portion.

Meter shall have a name plate clearly visible effectively secured against removal and indelibly and distinctly marked with all the essential particulars as per relevant standards  
i.e.

Manufacturer's name and trademark  
Manufacturer's serial number  
type and description  
Rated current voltage and frequency  
Relevant ISS/IEC No should be printed along with ISI certification mark.  
Manufacturer's meter constant shall invariably be indicated duly printed.  
Name of the owner, purchase order no. and date and month / year of manufacturing. Guarantee period

## **8.0 TESTS**

**Type Testing of Meter :** -The offered meter should be strictly in conformance to the tender specifications. The offered meters should be fully type tested at NABL accredited Laboratory only in accordance with Tender specifications, IS 14697 with latest amendments to be read along with CBIP Report 1988 with latest amendments. The Type test report should not be more than 2 years old. The attested photocopy of the Type Test results should be enclosed with the offer.

**8.1 Acceptance test :** -All acceptance test as per IS:14697/1999 with latest amendments, CBIP report No. 88 with latest amendments and IEC 687 with latest amendments ,shall be carried out in the meter

**8.2 Routine Test :** -All routine tests as per IS:14697/1999 with latest amendments, CBIP report No. 88 with latest amendments and IEC 687 with latest amendments ,shall be carried out in the meter

**8.3 PRE DESPATCH INSPECTION:-**All acceptance tests and inspection of meter / software

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shall be carried out at the place of manufacture unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchases. The manufacturer shall offer to the inspector representing the purchaser all the reasonable facilities, free of charge for inspection and testing to satisfy him that the materials is being supplied in accordance with this specifications. The Company's representative / Engineer attending the above testing will carry out testing as per IEC: 687, IS 14697 and CBIP report No. 88 and this specification and issue test certificate approval to the manufacturer and given clearance for despatch.

- 8.4 GUARANTEE :-**The meter shall be guaranteed for the period of five years from the date of commissioning or two and half year from the date of despatch, whichever is earlier. The meters found defective within the above guarantee period shall be replaced / repaired by the supplier free of cost within one month of receipt of intimation. If the defective meters / software / MRIs are not replaced / repaired within the specified period above the Company shall recover an equivalent amount from any the bills of the supplier.

**MINIMUM TESTING FACILITIES:-**Manufacturer should posses fully computerized meter test bench system for carrying out routine and acceptance tests as per IEC: 687, IS 14697 and CBIP report No. 88. In addition this facility should produce test reports for each and every meter.

## 9. MANUFACTURING ACTIVITIES:

Meter should be manufactured using SMT (surface mount technology ) component and by deploying automatic SMT price and place machine and reflow solder process. Further the bidder should own or have assured access (though hire, lease or subcontract ) of above facility.

Quality should be ensued at the following stages.

- (a) At PCB manufacturing stage, each Company shall be subjected to computerized bare Company testing.
- (b) At insertion stage all components should under go computerized testing for confirming to design parameters and orientation.
- (c) Complete assembled and soldered PVC should under go functional testing using automatic test equipments (ATEs).
- (d) Prior to final testing and Calibration all meters shall be subjected to aging test  
(i.e. metes will be kept in ovens for 72 hours at 55 deg. cent temperature and atmospheric humidity under real life condition at its full load current. After 72 hours meters should works satisfactorily ) to eliminate infant mortality.

The calibration of meters shall be done in house. The bidders should submit the list of all components used in meter alongwith the offer.

## 10. PACKING:-

Each meter may be suitably packed in the first instant to prevent ingress of moisture and dust and than placed in cushioned carton of a suitable material to prevent damage due to shocks during transit. The lid of the carton may be suitably sealed. Each meter be packed in separate cushioned carton. A suitable number of selected cartons may be packed in a



## **Volume – I Technical Specification for Grid Trivector Energy Meter**

case of adequate strength with extra cushioning if considered necessary. The cases may be properly sealed against accidental opening in transit. The packing cases should be marked to indicate the fragile nature of the contents.

- 11. DRAWING & TECHNICAL LEAFLETS:** -Detailed dimensional drawing along with the circuit diagram and detailed technical leaflets showing clearly the quantity or the material used for meters and its constructional features should be furnished along with the offer.
- 12. AFTER SALES SERVICE:** -In order to provide prompt and smooth after sales support / service etc. It shall be preferred to post / engage an engineer / technician in Delhi by the manufacturer, to attend any minor defects immediately and to educate the user about proper installation of meter and programming of MRI base computer taking reading billing data load survey tamper information etc. through MRI and download to PCs to get printouts etc.

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**ANNEXURE –A**

**DISPLAY SEQUENCE**

1. LCD SEGMENT CHECK
2. METER SERIAL NUMBER
3. REAL DATE AND TIME
4. INCOMING ACTIVE ENERGY (TOTAL)
5. OUTGOING ACTIVE ENERGY (TOTAL)
6. INCOMING REACTIVE ENERGY (TOTAL)
7. OUTGOING REACTIVE ENERGY (TOTAL)
8. INCOMING APPARENT ENERGY (TOTAL)
9. OUTGOING APPARENT ENERGY (TOTAL)
10. THREE PHASE POWER FACTOR (INSTANTANEOUS) WITH SIGN
11. LINE CURRENT L1 (INSTANTANEOUS)
12. LINE CURRENT L3 (INSTANTANEOUS)
13. LINE VOLTAGE L1 (INSTANTANEOUS)
14. LINE VOLTAGE L3 (INSTANTANEOUS)
15. FREQUENCY
16. INCOMING ACTIVE DEMAND (INSTANTANEOUS)
17. OUTGOING ACTIVE DEMAND (INSTANTANEOUS)
18. INCOMING APPARENT DEMAND (INSTANTANEOUS)
19. OUTGOING APPARENT DEMAND (INSTANTANEOUS)
20. INCOMING REACTIVE DEMAND (INSTANTANEOUS)
21. OUTGOING REACTIVE DEMAND (INSTANTANEOUS)
22. INCOMING MAXIMUM ACTIVE DEMAND (AT TIME T)
23. OUTGOING MAXIMUM ACTIVE DEMAND (AT TIME T)
24. INCOMING MAXIMUM REACTIVE DEMAND (AT TIME T)
25. OUTGOING MAXIMUM REACTIVE DEMAND (AT TIME T)
26. INCOMING MAXIMUM APPARENT DEMAND (AT TIME T)
27. OUTGOING MAXIMUM APPARENT DEMAND (AT TIME T)

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**ANNEXURE 'B'**

**LOAD SURVEY PARAMETERS (15 MINUTES INTEGRATION for last 38 days)**

S.NO	Description
1	AVERAGE ACTIVE DEMAND (OUTGOING)
2	AVERAGE ACTIVE DEMAND (INCOMING)
3	AVERAGE APPARENT DEMAND (OUTGOING)
4	AVERAGE APPARENT DEMAND (INCOMING)
5	PHASE VOLTAGE (INSTANTANEOUS) L1
6	PHASE VOLTAGE (INSTANTANEOUS) L3
7	PHASE CURRENT (INSTANTANEOUS) L1
8	PHASE CURRENT (INSTANTANEOUS) L3

**LOAD SURVEY PARAMETERS (Snapshot at 24:00 hours for last 38 days)**

1	Active Energy (Import)
2	Active Energy (Export)
3	Reactive Energy (Import)
4	Reactive Energy (Export)
5	Apparent Energy (Import)
6	Apparent Energy (Export)

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**ANNEXURE 'C'**

<b>INSTANTANEOUS BILLING PARAMETERS IN AMR</b>		
<b>Frequency- every 15 minutes</b>		
<b>S.NO</b>	<b>DESCRIPTION</b>	<b>Unit</b>
1	METER SERIAL NUMBER	.....
2	REAL DATE & TIME	.....
3	INCOMING AVERAGE DEMAND (ACTIVE POWER) IN LAST INTEGRATION PERIOD	kW
4	OUTGOING AVERAGE DEMAND (ACTIVE POWER) IN LAST INTEGRATION PERIOD	kW
5	INCOMING AVERAGE DEMAND (REACTIVE POWER) IN LAST INTEGRATION PERIOD	kVAr
6	OUTGOING AVERAGE DEMAND (REACTIVE POWER) IN LAST INTEGRATION PERIOD	kVAr
7	INCOMING AVERAGE DEMAND (APPARENT POWER) IN LAST INTEGRATION PERIOD	kVA
8	OUTGOING AVERAGE DEMAND (APPARENT POWER) IN LAST INTEGRATION PERIOD	kVA
9	INCOMING MAXIMUM ACTIVE DEMAND (AT TIME T)	kW
10	OUTGOING MAXIMUM ACTIVE DEMAND (AT TIME T)	kW
11	INCOMING MAXIMUM APPARENT DEMAND (AT TIME T)	kVA
12	OUTGOING MAXIMUM APPARENT DEMAND (AT TIME T)	kVA
13	INCOMING MAXIMUM REACTIVE DEMAND (AT TIME T)	kVAr
14	OUTGOING MAXIMUM Reactive DEMAND (AT TIME T)	kVAr
15	INCOMING ACTIVE ENERGY (TOTAL)	kWh
16	OUTGOING ACTIVE ENERGY (TOTAL)	kWh
17	INCOMING REACTIVE ENERGY (TOTAL)	kVArh
18	OUTGOING REACTIVE ENERGY (TOTAL)	kVArh
19	INCOMING APPARENT ENERGY (TOTAL)	kVAh
20	OUTGOING APPARENT ENERGY (TOTAL)	kVAh
21	THREE PHASE POWER FACTOR (INSTANTANEOUS) WITH SIGN	
22	PHASE CURRENT L1 (INSTANTANEOUS)	AMP
23	PHASE CURRENT L3 (INSTANTANEOUS)	AMP
24	Line VOLTAGE L1 (INSTANTANEOUS)	VOLT
25	Line VOLTAGE L3 (INSTANTANEOUS)	VOLT
26	FREQUENCY (INSTANTANEOUS)	Hz
27	INCOMING ACTIVE DEMAND (INSTANTANEOUS)	kW
28	OUTGOING ACTIVE DEMAND (INSTANTANEOUS)	kW
29	INCOMING APPARENT DEMAND (INSTANTANEOUS)	kVA
30	OUTGOING APPARENT DEMAND (INSTANTANEOUS)	kVA
31	INCOMING REACTIVE DEMAND (INSTANTANEOUS) WITH SIGN("+" for LAG "-" for Lead)	kVAr
32	OUTGOING REACTIVE DEMAND (INSTANTANEOUS) WITH SIGN("+" for LAG "-" for Lead)	kVAr



**Specification for**  
**OUTDOOR**  
**POTENTIAL TRANSFORMER**  
**(33 & 66KV)**

**Specification no. SP-PTLU-01-R1**

Prepared by:		Checked by :		Approved by:		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
DS		HPB		DG		01	29 -Jan-05
Tanu		Meenakshi		K.K.Alla		02	16-July-14

**Volume – I Technical Specification for 66KV Outdoor PT**

Record of Revision

Sl. no.	Revision no.	Clause No.	Nature of change	Approved by
1.	R1	2.3.2	Material of tank construction shall be hot dip galvanized with minimum thickness of 610gm/sq mm	MDB/KKA
2.	R1	3.0.0	ABIL included in approved makes of insulators	MDB/KKA
3.	R1	6.1.1	Type Test to be conducted from CPRI/ERDA	MDB/KKA
4.	R1	Annexure C, 10.4	Accuracy class of metering core shall be 0.2	MDB/KKA

## Volume – I Technical Specification for 66KV Outdoor PT

### General Specification

#### 1.0 CODES & STANDARDS:

Materials, equipment and methods used in the manufacture of Potential Transformer shall conform to the latest edition of following –

##### National Standard

Standard Code	Standard Description
IS-3156 (Part I to IV)	Specification for Voltage transformer.
IS-4146	Application guide for voltage transformer.
IS-2099	High voltage porcelain bushings
IS-731	Insulator for O/H power line
IS-335	New insulating oil for transformer and switchgear.
IS-9676	Reference ambient temperature of electrical equipment
IS-5561	Specification of electric power connectors
IS-5621	Hollow insulator for use in electrical equipments
IS-3156 (Part I to IV)	Specification for Voltage transformer.
IS-4146	Application guide for voltage transformer.
IS-2099	High voltage porcelain bushings
IS-731	Insulator for O/H power line
	Indian Electricity Rules (relevant safety regulation of CEA)
	Indian electricity act
	CBIP manual

#### 2.0 MAJOR DESIGN CRITERIA & PARAMETERS OF THE PT

	Description	Requirement / Rating	
2.1.0	System	66KV	33KV
2.1.1	Voltage	66KV $\pm$ 10%	33KV $\pm$ 10%
2.1.2	Frequency	50HZ $\pm$ 5%	50HZ $\pm$ 5%
2.1.3	Fault level	31.5KA for 3secs.	26.3KA for 3secs.
2.1.4	Earthing	Solidly grounded	
2.2.1	Type	Single phase, outdoor, dead tank type, oil immersed, self cooled type.	
2.2.2	Construction feature	Oil immersed PT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture.	
2.3.0	<b>Major Parts</b>		
2.3.1	Tank		
2.3.2	Material of Construction	Tank shall be of Galvanized Steel. Minimum galvanizing thickness shall be 610gm/sq mm	
2.3.3	Tank Feature	The tank shall be provided with oil draining plug, Oil level gauge glass.	

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2.3.4	Oil Expansion	Stainless steel bellow or diaphragm shall be provided to take care of oil expansion
2.3.5	Core	High grade, non ageing, low loss, high permeability, cold rolled grain oriented silicon steel lamination.
2.4.0	<b>Winding</b>	
2.4.1	Material	Electrolytic Copper
2.4.2	Winding Insulating material	Class A, non catalytic, inert to transformer oil, free from compounds liable to ooze out, shrink or collapse.
2.4.3	Winding Insulation	Uniform
2.4.4	Design features	Winding shall be capable of desired output as per specified limits without exceeding permissible temperature rise.
2.5.0	<b>Insulating oil</b>	
2.5.1	Type	Class 1 new mineral insulating oil as per IS 335, shall be certified not to contain PCBs. Anti oxidant inhibitor if recommended shall be subject to Purchaser's approval.
2.6.0	<b>Bushings and Terminations</b>	
2.6.1	Type	Porcelain bushing
2.6.2	Termination on HV side bushing	The HV Terminal shall be of copper. Termination shall be by bimetallic of Aluminum alloy grade A6 suitable for Twin Zebra ACSR conductor..
2.6.3	Termination of LV side	The secondary terminals shall be provided in IP55 Box with Brass/copper stud type terminals accessible from front with removable cover.
2.6.4	Termination of Earth terminal of HV winding	The earth terminal of HV winding shall be bought out in secondary Terminal box by bushing. This shall be connected with body earth terminal with flexible copper lead through a link.
2.6.5	Terminal marking	Terminals shall be marked as per IS 3156
2.7.1	Minimum creepage distance of bushing	31 mm/KV
2.8.1	Protected creepage distance	At least 50 % of total creepage distance
2.9.1	Over Voltage factor	1.2 times for continuous rating and 1.5 times for 30 seconds.
2.10.1	Atmospheric protection for clamp and fitting of iron and steel	Hot dip galvanizing as per IS 2633
2.10.2	Gland Plate	Min. 3 mm thick detachable with three knockout holes of 3/4 inch.
2.10.3	Cable entry	Bottom for all cables
2.11.1	Earthing	The PT assembly comprising of the chasis, frame work and fixed parts of metal casing shall be provided with two separate body earthing terminals.



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### 3.0 FITTINGS & ACCESSORIES ON POTENTIAL TRANSFORMER

3.1.0	Rating and Diagram Plate	Required
3.1.1	Material	Anodized Aluminum 16SWG
3.1.2	Background	SATIN SILVER
3.1.3	Letters, diagram & border	Black
3.1.4	Process	Etching
3.2.5	Name plate details	Required
3.3.6	Terminal marking of Primary and secondary terminals.	Required
3.4.0	Drain Plug on tank Base	Required

### 4.0 APPROVED MAKE OF COMPONENTS

4.1.0	Insulator	CJI/JSI/WSI/Modern/Saravana/BHEL/ABIL
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### 5.0 QUALITY ASSURANCE

5.1	Vendor quality plan	To be submitted for purchaser approval.
5.2	Inspection point	To be mutually identified and agreed in quality plan.

### 6.0 PROGRESS REPORTING

6.1	Out Line Document	To be submitted for purchase approval for outline of production, inspection, testing, inspection, packing, dispatch, documentation programme.
6.2	Detailed Progress Report	To be submitted to purchaser once a month containing <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> <li>vi) Details of test failures if any in manufacturing stages</li> </ul>

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		vii) Progress on final box up constraints / Forward path
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**7.0 DRAWING, DATA & MANUALS**

7.1.0	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 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>
7.2.0	After award of contract, seller has to submit mentioned drawings for buyer's Approval (A ) / Reference (R)	<ul style="list-style-type: none"> <li>i) Programme for production and testing (A)</li> <li>ii) Guaranteed Technical Particulars (A)</li> <li>iii) Calculations to substantiate choice of electrical , structural , mechanical</li> </ul>

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		<p>component size / ratings (A)</p> <p>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)</p> <p>v) Terminal arrangement &amp; cable box details etc. (as applicable) (A)</p> <p>vi) Drawing for major components (A)</p> <p>vii) Rating &amp; Diagram plate (A)</p> <p>viii) Detailed loading drawing to enable the buyer to design and construct foundations (as applicable ) (R)</p> <p>ix) Transport / Shipping dimensions with weights, wheel base details, untanking height etc. (As applicable ) (R)</p> <p>x) List of makes of all fittings and accessories (A)</p> <p>xi) Detailed installation and commissioning instructions ( R)</p> <p>xii) Quality plan</p>
7.3.0	Submittals required prior to dispatch	<p>i) Inspection and test reports, carried out in manufacturer's work (R )</p> <p>ii) Test certificates of all bought out items</p> <p>iii) Operation and maintenance instruction as well as trouble shooting chart / manuals.</p> <p>iv)</p>
7.4.0	Drawing and document size	Standard size paper A0, A1 , A2, A3, A4
7.5.0	No of drgs./Documents required at different stages	As per Annexure A scope of supply

**8.0 INSPECTION & TESTING**

8.1.0	Inspection and Testing during manufacture	
8.2.0	Tank	<p>i) Checking of dimensions as per approved drawing.</p> <p>ii) Checking for leakage by pressure testing.</p> <p>iii) Thickness of Galvanization shall be 610gm/ sq mm</p>
8.3.0	Porcelain	<p>i) Check dimension.</p> <p>ii) Check finish of sealing surface.</p>

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		iii) iv) v)	Check creepage distance. Check for routine electrical test. Check for porosity and temperature cycle test.
8.4.0	Insulating Materials	i) ii) iii)	Sample check for physical properties of materials. Check for dielectric strength. Visual and dimensional checks.
8.5.0	Copper conductor	i) ii) iii) iv)	Check for dimension. Check for elongation. Check for unidirectional scrap. Check for heat shock.
8.6.0	Oil	i) ii) iii) iv) v) vi) vii) viii) ix)	Check for break down voltage. Check for density. Check for flash point. Check for moisture content. Check for neutralization value. Check for inter facial tension at 27 Deg c. Check for sludge content. Check for specific resistance. Check for pour point.
8.7.0	Secondary terminals	i)	Check for one min AC Test
8.8.0	Routine tests		Tests shall be carried out in accordance with IS 3156
8.9.0	Type Tests	a) b)	On one PT of each rating and type tested from CPRI/ERDA All the test as per IS 3156
		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.
8.10.0	Acceptance test		To be performed in presence of Purchaser at manufacturer works:- i) Physical inspection of dimensions and BOM. ii) Verification of terminal marking and polarity. iii) Power frequency dry withstand tests on primary winding. iv) Power frequency dry withstand tests on secondary winding. v) Partial discharge test ( this shall be only for future reference) vi) Determination of ratio and phase angle errors according to the appropriate designation or accuracy class.

## 9.0 PACKING , SHIPPING, HANDLING AND STORAGE

9.0.0	Packing	
9.1.1	Packing protection	Against corrosion , dampness, heavy rains, breakage and vibration
9.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection and identification labels.

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9.1.3	Packing identification label	In each packing case, following details are required : i) Individual serial number ii) Purchaser's name iii) PO number (along with SAP item code , if any) & date iv) Equipment Tag no. (if any) v) Destination vi) Manufacturer / Supplier's name vii) Address of manufacturer's / supplier's its agent viii) Description and quantity ix) Country of origin x) Month and year of manufacturing xi) Case measurement xii) Gross and net weight in kilograms xiii) All necessary slinging and stacking instructions.
9.1.4	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. Any modification required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser. ii) The seller shall be responsible for all transit damage due to improper packing.
9.1.5	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual need to be furnished before commencement of supply.

## 10.0 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.

### Annexure –A Scope of supply

1.0 The scope of supply shall include following

1.1 Design, manufacture, assembly, testing at storages of manufacturing as per C I. 12 of this specification, final testing at manufacturer works on completely assembled transformer

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before dispatch, packing delivery and submission of all documentation for the Power transformer with all accessories as below

Sr. No.	Description	Scope of Supply
1.0	Fully assembled PT with all major parts like Tank, bushing, Primary terminal with connector and secondary terminal box.	YES
1.1	Galvanised steel structure for PT	NO
1.2	Fixing Bolts for PT	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 PT as site

1.3 BOQ as following-

Sr. No.	Purchaser Equipment Tag No. / SAP code	Location / Substation name	Unit	Quantity
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

	Along with offer	For Approval after award of contract	Final after approval	Remarks
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 for the transformer	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

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3.3 Material dispatch clearance - after inspection by purchaser and written dispatch clearance for purchaser

### Annexure – B SERVICE CONDITIONS

1.0.0	Mumbai Atmospheric conditions	
a)	Average grade atmosphere	Heavy polluted , salt Laden, dusty, humid with possibility of condensation
	Maximum altitude above sea level	1000 M
b)	Ambient Air temperature	Highest 45 deg C, Average 35 deg C
	Maximum ambient air temperature	20 deg C
c)	Relative Humidity	100 % Max
d)	Thermal Resistivity of Soil	150 deg. C cm/W
e)	Seismic Zone	3 as per IS 1893
f)	Rainfall	3000 mm concentrated in four months

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

**Volume – I Technical Specification for 66KV Outdoor PT**

**Annexure C1 GURANTEED TECHNICAL PARTICULARS FOR 66 KV PT**

Sr. No.	Description	Data By Purchaser	Data By Supplier
1.0	Location of Equipment	Project specific to be filled up	
2.0	Name of Manufacturer		
3.0	Address & Contact details		
4.0	Type	Single phase, outdoor, dead tank type, oil immersed, self-cooled hermetically sealed type.	
5.0	Manufacturer Model No		
6.0	Reference design ambient temperature	50 Deg C	
7.0	Reference Standard	IS: 3156 (Part1 to 4)	
8.0	Nominal system voltage	66KV	
9.0	Highest system voltage	72.5KV	
10.0	Basic Insulation level	325KVp	
11.0	Power frequency voltage	140KV	
12.0	Type of cooling	ONAN	
13.0	Rated frequency (Hz)	50 Hz	
14.0	Insulation Class	A	
15.0	Rated Primary voltage	66KV / $\sqrt{3}$	
16.0	Rated secondary voltage	110V / $\sqrt{3}$	
17.0	Number of secondary cores	Two	
18.0	<b>CORE Specifications</b>		
18.1	Core - 1		
18.2	Purpose	Metering	
18.3	Rated Output	50 VA	
18.4	Class of accuracy	0.2	
18.5	Ratio error	As per IS	
18.6	Phase angle error	As per IS	
19.0	Core - 2		
19.1	Purpose	Protection	
19.2	Rated Output	50 VA	
19.3	Class of accuracy	3P	
19.4	Ratio error	As per IS	
19.5	Phase angle error	As per IS	
20.0	Rated over voltage factor		
20.1	- Continuous	1.2 times	
20.2	- 30 Seconds	1.5 times	
21.0	Temperature rise above an ambient of 50Deg C at 1.2 times voltage factor for 30 seconds rating		
21.1	- For Winding	50 Deg C	



**Volume – I Technical Specification for 66KV Outdoor PT**

21.2	- For Oil	40 Deg C	
22.0	Temperature rise above an ambient of 50Deg C at 1.5 times voltage factor for 30 seconds rating		
22.1	- For Winding	50 Deg C	
22.2	- For Oil	40 Deg C	
23.0	One minute power frequency dry withstand voltage for 66 kV PT (KV rms)		
24.0	One minute power frequency wet withstand voltage for 66 kV PT (KV rms)		
25.0	1.2/50 microsecond impulse withstand test voltage for 66 KV PT (KV rms)	325 KVp	
26.0	One minute Power frequency withstand voltage on secondary winding	3KV	
27.0	Minimum creepage distance in mm for 66KV PT	2250 mm	
28.0	Protective creepage distance in mm for 66KV PT	1125 mm	
29.0	Partial discharge test, whether will be carried out Yes / No		
30.0	Weight of core		
31.0	Weight of oil		
32.0	Total weight		
33.0	Mounting details		
34.0	Overall dimensions		

**Volume – I Technical Specification for 66KV Outdoor PT**

**Annexure –D RECOMMENDED SPARES (DATA BY SUPPLIER)**

List of recommended spares as following –

Sr. No.	Description of spare part	Unit	Quality
1			
2			
3			
4			
5			
6			



**Specification for**  
**66KV OUTDOOR**  
**CAPACITIVE VOLTAGE TRANSFORMER**  
**(CVT)**

**Specification no. SP-CVT-01-R0**

Prepared by:		Checked by :		Approved by:		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
Tanu		Meenakshi		K.K.Alla		02	16-July-14

## Volume – I Technical Specification for 66KV Outdoor CVT

### 1.0 CODES & STANDARDS:

Materials, equipment and methods used in the manufacture of Potential Transformer shall conform to the latest edition of following –

#### National Standard

Standard Code	Standard Description
IS-3156 (Part I to IV)	Specification for Voltage transformer.
IS-4146	Application guide for voltage transformer.
IS-2099	High voltage porcelain bushings
IS-731	Insulator for O/H power line
IS-335	New insulating oil for transformer and switchgear.
IS-9676	Reference ambient temperature of electrical equipment
IS-5561	Specification of electric power connectors
IS-5621	Hollow insulator for use in electrical equipments
IS-3156 (Part I to IV)	Specification for Voltage transformer.
IS-4146	Application guide for voltage transformer.
IS-2099	High voltage porcelain bushings
IS-731	Insulator for O/H power line
	Indian Electricity Rules (relevant safety regulation of CEA)
	Indian electricity act
	CBIP manual

### 2.0 MAJOR DESIGN CRITERIA & PARAMETERS OF THE CVT

	Description	Requirement / Rating
2.1.0	Rated Voltage	66KV
2.1.1	Highest System Voltage	72.5kV
2.1.2	Frequency	50HZ $\pm$ 5%
2.1.3	Fault level	31.5KA for 3secs.
2.1.4	Earthing	Solidly grounded
2.2.1	Type	Single phase, outdoor, dead tank type, oil immersed, self cooled type.
2.2.2	Construction feature	Oil immersed CVT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture.

**Volume – I Technical Specification for 66KV Outdoor CVT**

2.3.0	<b>Features</b>	<p>a) Shall comprise a capacitor divider unit and an electromagnetic unit such that secondary voltage of electromagnetic unit is substantially proportional to and in phase with the primary voltage applied to capacitor divider units.</p> <p>b) Capacitors shall be oil impregnated type enclosed in inert gas atmosphere, hermetically sealed.</p> <p>c) The material and construction and assembly of CVT shall be such that the capacitance does not change with time and the effect of temperature is minimum.</p> <p>d) Provided with an over voltage suppressor</p> <p>e) No radio interference when operated at maximum service voltage</p> <p>f) Reactance to be provided to minimize draining of carrier signal in electromagnetic unit</p> <p>g) No radio interference when operated at maximum service voltage</p> <p>h) The CVT shall be designed to cover its rated output range without any adjustment of its electromagnetic unit.</p> <p>i) Material used in insulation and assembly of the winding shall be insoluble, non catalytic and chemically inactive in hot transformer oil and shall not be subjected to a shrinking and seasoning process</p> <p>j) CVT shall provide designed transient response requirement as per IEC / IS i.e. during transient oscillations following a short circuit on primary side, the secondary side output voltage shall not fall to a value less than 10% of peak value before short circuit within 20 milliseconds</p> <p>k) The secondary terminal box shall include necessary HRC fuses for protection of secondary circuits and both the sides of fuse shall be terminated on terminal block for fuse supervision.</p>
2.4.0	<b>Major Parts</b>	
2.4.1	Tank	
2.4.2	Material of Construction	Tank shall be of high quality steel and shall be Hot Dip Galvanized with galvanizing thickness of 610gm/sq mm minimum.
2.4.3	Tank Feature	The tank shall be provided with oil draining plug, Oil level gauge glass.
2.4.4	Oil Expansion	Stainless steel bellow or diaphragm shall be provided to take care of oil expansion
2.4.5	Core	High grade, non ageing, low loss, high

**Volume – I Technical Specification for 66KV Outdoor CVT**

		permeability, cold rolled grain oriented silicon steel lamination.
2.5.0	Winding	
2.5.1	Material	Electrolytic Copper
2.5.2	Winding Insulating material	Class A, non catalytic, inert to transformer oil, free from compounds liable to ooze out, shrink or collapse.
2.5.3	Winding Insulation	Uniform
2.5.4	Design features	Winding shall be capable of desired output as per specified limits without exceeding permissible temperature rise.
2.6.0	Insulating oil	
2.6.1	Type	Class 1 new mineral insulating oil as per IS 335, shall be certified not to contain PCBs. Anti oxidant inhibitor if recommended shall be subject to Owner's approval.
2.7.0	Bushings and Terminations	
2.7.1	Type	Porcelain bushing
2.7.2	Termination on HV side bushing	The HV Terminal shall be of copper. Termination shall be by bimetallic of Aluminum alloy grade A6 suitable for Twin Zebra ACSR conductor/ 3inch Pipe Bus.
2.7.3	Termination of LV side	The secondary terminals shall be provided in IP55 Box with Brass/copper stud type terminals accessible from front with removable cover.
2.7.4	Termination of Earth terminal of HV winding	The earth terminal of HV winding shall be brought out in secondary Terminal box by bushing. This shall be connected with body earth terminal with flexible copper lead through a link.
2.7.5	Terminal marking	Terminals shall be marked as per IS 3156
2.8.1	Minimum creepage distance of bushing	31 mm/KV
2.8.1	Protected creepage distance	At least 50 % of total creepage distance
2.9.1	Over Voltage factor	1.2 times for continuous rating and 1.5 times for 30 seconds.
2.10.1	Atmospheric protection for clamp and fitting of iron and steel	Hot dip galvanizing as per IS 2633
2.10.2	Gland Plate	Min. 3 mm thick detachable with three knockout holes of 3/4 inch.
2.10.3	Cable entry	Bottom for all cables
2.11.1	Earthing	The CVT assembly comprising of the chassis, frame work and fixed parts of metal casing shall be provided with two separate body earthing terminals.
2.12.1	External finish	Shall be Hot Dip galvanized

## Volume – I Technical Specification for 66KV Outdoor CVT

### 3.0 FITTINGS & ACCESSORIES ON POTENTIAL TRANSFORMER

3.1.0	Rating and Diagram Plate	Required
3.1.1	Material	Anodized Aluminum 16SWG
3.1.2	Background	SATIN SILVER
3.1.3	Letters, diagram & border	Black
3.1.4	Process	Etching
3.2.5	Name plate details	Required
3.3.6	Terminal marking of Primary and secondary terminals.	Required
3.4.0	Drain Plug on tank Base	Required

### 4.0 APPROVED MAKE OF COMPONENTS

4.1.0	Insulator	CJI/JSI/WSI/Modern/Saravana/BHEL/ABIL
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### 5.0 TESTING & INSPECTION

5.1.0	Inspection and Testing during manufacture	
5.2.0	Tank	i) Checking of dimensions as per approved drawing. ii) Checking for leakage by pressure testing. iii) Thickness of Paint or Galvanization, as applicable
5.3.0	Porcelain	i) Check dimension. ii) Check finish of sealing surface. iii) Check creepage distance. iv) Check for routine electrical test. v) Check for porosity and temperature cycle test.
5.4.0	Insulating Materials	i) Sample check for physical properties of materials. ii) Check for dielectric strength. iii) Visual and dimensional checks.
5.5.0	Copper conductor	i) Check for dimension. ii) Check for elongation. iii) Check for unidirectional scrap. iv) Check for heat shock.
5.6.0	Oil	i) Check for break down voltage. ii) Check for density. iii) Check for flash point. iv) Check for moisture content. v) Check for neutralization value. vi) Check for inter facial tension at 27 Deg c. vii) Check for sludge content. viii) Check for specific resistance. ix) Check for pour point.
5.7.0	Secondary terminals	i) Check for one min AC Test
5.8.0	Routine tests	Tests shall be carried out in accordance with IS 3156
5.9.0	Type Tests	a) On one CVT of each rating and type (In CPRI/ERDA) b) All the test as per IS 3156

**Volume – I Technical Specification for 66KV Outdoor CVT**

		b) 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.
5.10.0	Acceptance test	<p>To be performed in presence of Owner at manufacturer works:-</p> <ul style="list-style-type: none"> <li>i) Physical inspection of dimensions and BOM.</li> <li>ii) Verification of terminal marking and polarity.</li> <li>iii) Power frequency dry withstand tests on primary winding.</li> <li>iv) Power frequency dry withstand tests on <ul style="list-style-type: none"> <li>• <i>secondary winding</i></li> <li>• <i>Capacitor voltage divider</i></li> <li>• <i>Low-voltage terminal of the capacitor voltage divider.</i></li> <li>• <i>Electromagnetic unit</i></li> </ul> </li> <li>v) Partial discharge test ( this shall be only for future reference)</li> <li>vi) Determination of ratio and phase angle errors according to the appropriate designation or accuracy class.</li> </ul>

**6.0 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.



## Volume – I Technical Specification for 66KV Outdoor CVT

### Annexure –A Scope of supply

- 1.0 The scope of supply shall include following
- 1.1 Design, manufacture, assembly, testing at storages of manufacturing as per C I. 12 of this specification, final testing at manufacturer works on completely assembled transformer before dispatch, packing delivery and submission of all documentation for the Power transformer with all accessories as below

Sr. No.	Description	Scope of Supply
1.0	Fully assembled PT with all major parts like Tank, bushing, Primary terminal with connector and secondary terminal box.	YES
1.1	Galvanised steel structure for PT	NO
1.2	Fixing Bolts for PT	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 PT as site

- 1.3 BOQ as following-

Sr. No.	Purchaser Equipment Tag No. / SAP code	Location / Substation name	Unit	Quantity
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

	Along with offer	For Approval after award of contract	Final after approval	Remarks
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 for the transformer	1 copy		6 copies + 1 soft copy in CD	

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Test Report	2 copy		6 copies + 1 soft copy in CD	Type test and sample routine test reports
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**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 |

## Volume – I Technical Specification for 66KV Outdoor CVT

### Annexure – B SERVICE CONDITIONS

1.0.0	Mumbai Atmospheric conditions	
a)	Average grade atmosphere	Heavy polluted , salt Laden, dusty, humid with possibility of condensation
	Maximum altitude above sea level	1000 M
b)	Ambient Air temperature	Highest 45 deg C, Average 35 deg C
	Maximum ambient air temperature	20 deg C
c)	Relative Humidity	100 % Max
d)	Thermal Resistivity of Soil	150 deg. C cm/W
e)	Seismic Zone	3 as per IS 1893
f)	Rainfall	3000 mm concentrated in four months

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

**Volume – I Technical Specification for 66KV Outdoor CVT**

**Annexure – C: Guaranteed Technical Particulars 66 KV OUT DOOR CAPACITIVE  
VOLTAGE TRANSFORMER**

	Description	Data By Purchaser	Data By Supplier
1.0	Location of Equipment	Project specific to be filled up	
2.0	Name of Manufacturer		
3.0	Address & Contact details		
4.0	Type	Single phase, outdoor, dead tank type, oil immersed, self-cooled, hermetically sealed type	
5.0	Manufacturer Model No		
6.0	Reference design ambient temperature	50 Deg C	
7.0	Reference Standard	IS: 3156 (Part1 to 4)	
8.0	Nominal system voltage	66KV	
9.0	Highest system voltage	72.5KV	
10.0	Basic Insulation level	325KVp	
11.0	Power frequency voltage	140KV	
12.0	Type of cooling	ONAN	
13.0	Rated frequency (Hz)	50 Hz	
14.0	Insulation Class	A	
15.0	Rated Primary voltage	66KV / $\sqrt{3}$	
16.0	Rated secondary voltage	110V / $\sqrt{3}$	
17.0	Number of secondary cores	Two	
18.0	<b>CORE Specifications</b>		
18.1	Core - 1		
18.2	Purpose	Metering	
18.3	Rated Output	50 VA	
18.4	Class of accuracy	0.2	
18.5	Ratio error	As per IS	
18.6	Phase angle error	As per IS	
19.0	Core - 2		
19.1	Purpose	Protection	
19.2	Rated Output	50 VA	
19.3	Class of accuracy	3P	
19.4	Total Simultaneous Burden		
19.5	Total Thermal Burden		
19.4	Ratio error	As per IS	
19.5	Phase angle error	As per IS	
20.0	Rated over voltage factor		
20.1	- Continuous	1.2 times	
20.2	- 30 Seconds	1.5 times	
21.0	<b>Capacitor Divider</b>		
21.1	High voltage Capacitor	C1(pf)	
21.2	Intermediate Voltage Capacitor	C2(pf)	

**Volume – I Technical Specification for 66KV Outdoor CVT**

21.3	Total Equivalent Capacitance	Pf	
21.4	Rated temperature at which above values are indicated.	Deg C	
21.5	Capacitance temperature coefficient		
21.6	Tan delta value of capacitance		
21.7	Carrier frequency coupling	Pf	
21.8	Rated Intermediate Voltage		
22.0	Natural frequency of coupling	kHz	
23.0	Band Width	kHz	
24.0	Series reactance/choke rated Voltage & power frequency withstand voltage		
24.0	Temperature rise above an ambient of 50Deg C at 1.2 times voltage factor for 30 seconds rating		
24.1	- For Winding	Deg C	
24.2	- For Oil	Deg C	
25.0	Temperature rise above an ambient of 50Deg C at 1.5 times voltage factor for 30 seconds rating		
25.1	- For Winding	Deg C	
25.2	- For Oil	Deg C	
26.0	One minute power frequency dry& wet withstand voltage of capacitor	140kVrms	
27.0	One minute power frequency withstand voltage of H.F terminal		
28.0	1.2/50 microsecond impulse withstand test voltage	325 KVp	
29.0	One minute Power frequency withstand voltage on secondary winding	3KV	
30.0	Corona extinction voltage	kV	
31.0	Max Radio Interference voltage at $1.1 \times U_m / \sqrt{3}$	V	
32.0	Minimum creepage distance in mm	2250 mm	
33.0	Protective creepage distance in mm	1125 mm	
34.0	Partial discharge test, whether will be carried out Yes / No		
35.0	Weight of core		

**Volume – I Technical Specification for 66KV Outdoor CVT**

36.0	Weight of oil		
37.0	Total weight		
38.0	Mounting details		
39.0	Overall dimensions		

**Annexure –D RECOMMENDED SPARES (DATA BY SUPPLIER)**

List of recommended spares as following –

Sr. No.	Description of spare part	Unit	Quality
1			
2			
3			
4			
5			
6			



## **Specification**

### **OUTDOOR CURRENT TRANSFORMER**

**(33 & 66 KV)**

**Specification no. SP-CTLU-01-R1**

Prepared by:		Checked by :		Approved by:		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
DS		HPB		DG		01	29 -Jan-05
Tanu		Meenakshi		K.K.Alla		02	16-July-14

**Volume – I Technical Specification for 66KV Outdoor CT**

Record of Revision

Sl. no.	Revision no.	Clause No.	Nature of change	Approved by
1.	R1	2.2	All ferrous parts, CT tank and other metallic parts exposed to atmosphere shall be hot dip galvanised with galvanising thickness of 610gm/sqmm minimum.	MDB/KKA
2.	R1	3.0.0	ABIL included in approved makes of insulators	MDB/KKA
3.	R1	6.1.1	Type Test to be conducted from CPRI/ERDA	MDB/KKA
4.	R1	Annexure C, 10.4	Accuracy class of metering core shall be 0.2s	MDB/KKA
5.	R1	Annexure C, 10.7	Knee point voltage & corresponding exciting current (project specific) shall be greater than or equal to 40 (RCT+8)	MDB/KKA
6.	R1	Annexure C, 10.8	Magnetizing current at $V_k/2$ (project specific) shall be less than or equal to 30 mA	MDB/KKA



## Volume – I Technical Specification for 66KV Outdoor CT

### 1.0 CODES & STANDARDS:

The current transformer shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard, IEC standard and CBIP manuals as listed below –

#### National Standard

Standard Code	Standard Description
Indian electricity act	
CBIP manual	
IS- 335	New insulating oil
IS-2705 (Part I to V)	Specification for current transformer.
IS-4201	Application guide for current transformer.
IS-2099	High voltage porcelain bushings
IS-731	Insulator for O/H power line
IS-335	New insulating oil for transformer and switchgear.
IS-9676	Reference ambient temperature of electrical equipment
IS-5561	Specification of electric power connectors
IS-9676	Summation current transformer
IS-4201	Application guide for current transformer
IS-2099	High voltage porcelain bushings
IS-5621	Hollow insulator for use in electrical equipment

#### International Standard

Standard Code	Standard Description
IEC: 137	Bushing for alternating current above 1000V
IEC: 185	Specification for current transformers
IEC: 439	Specification for Terminal box / Marshalling box

### 2.0 DESIGN FEATURES

	Description	Requirement / Rating
2.1	Type	Shall be dead tank type; oil immersed, self-cooled outdoor type.
2.2	Construction	a) Oil immersed CT shall be hermetically sealed to eliminate breathing and to prevent air and moisture. The core and winding shall be provided in porcelain bushing. Provision for oil expansion without breathing to be provided (diaphragm or bellow as per manufacturer design). b) All ferrous parts, CT tank and other metallic parts exposed to atmosphere shall be hot dip galvanized. c) Galvanising thickness shall be 610gm/sqmm minimum
2.3	Core	The core shall be of high-grade non-ageing, electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over current conditions. The saturation factor of the core shall be low enough not to cause any damage to measuring instruments in the event of maximum short circuit current.
2.4	Winding	The winding shall be suitable for simultaneous 100% full load continuous rating. The winding shall be capable of desired output as per specified limit.
2.5	Insulation	The current transformer shall withstand satisfactorily the

## Volume – I Technical Specification for 66KV Outdoor CT

		dielectric test voltage corresponding to basic insulation level specified.
2.6	Insulation Oil	The quantity of insulating oil in each current transformer shall be best available and the complete specification of the oil shall be furnished with the tender. The current transformer offered shall be hermetically sealed completely filled with insulating oil with provision to replace the oil. Oil level indication shall be provided.
2.7	Bushing	Porcelain used in bushing manufacture shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality. Glazing of the porcelain shall be uniform brown color free blisters, burns and similar defects. The bushing shall be designated to have ample insulation, mechanical strength and rigidity.
2.8	Creepage distance	Not less than 31mm /KV
2.9	Terminal Connectors	
2.9.1	Primary	The current transformers offered shall be supplied with Aluminum- alloy terminal connector with bimetallic sleeve, suitable for connection with single/double ACSR conductor.
2.9.2	Secondary	All the secondary terminals shall be bought in IP55 box with brass/ copper stud type terminals. The secondary terminals shall be shorted by brass/copper links before dispatch. Terminal box to be provided with earthing stud
2.10	Terminal Marking	Terminal marking shall be as per IS 2705

### 3.0 APPROVED MAKE OF COMPONENTS

3.1.0	Insulator	JSI/WSI/Modern/Saravana/BHEL/ABIL
3.2.0	Terminals	Connectwell / Elmex

### 4.0 NAME PLATE & TERMINAL MARKING

4.1.0	Name Plate	
4.1.1	Material	Anodized Aluminium 16SWG
4.1.2	Background	SATIN SILVER
4.1.3	Letters, diagram & border	Black
4.1.4	Process	Etching
4.1.5	Name plate details	Manufacturer name & address, year of manufacturer, Serial number and type designation, Rated Primary & secondary current, rated frequency, rated output and accuracy class, Highest system voltage, Rated Insulation level, Rated short-time thermal current or short time factor with rated time, Rated dynamic current, Reference Standard.
4.2.0	Danger plate on front & rear side	Not required

### 5.0 QUALITY ASSURANCE

5.1.0	Vendor quality plan	To be submitted for purchaser approval
5.2.0	Inspection points	To be mutually identified & agreed in quality plan

## Volume – I Technical Specification for 66KV Outdoor CT

### 6.0 INSPECTION & TESTING

6.1.0	Test	Test shall be carried out in accordance with IS-2705 / IEC-185
6.1.1	Type test	<p>a) Following type test shall be carried out on current transformer-</p> <ul style="list-style-type: none"> <li>- Short-time current test</li> <li>- Temperature-rise test</li> <li>- Lightning impulse test</li> <li>- HV power frequency wet withstand voltage test on CT</li> <li>- Determination of errors</li> </ul> <p>b) Current transformer must be of type tested from CPRI/ERDA and reports shall be submitted.</p> <p>c) In case the product is never type tested earlier, seller has to conduct the type tests from CPRI/ERDA at their own cost, before commencement of supply.</p>
6.1.2	Routine test	Test shall be carried out in accordance with IS-2705 / IEC-185
6.1.3	Acceptance test	Test shall be carried out in accordance with IS-2705 / IEC-185
6.2.0	Test on fitting and accessories	As per manufacturer's standard
6.3.0	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, 10 days in advance to Purchaser.

### 7.0 DRAWINGS, DATA & MANUALS

7.1.0	To be submitted along with bid	<p>The seller has to be submit :</p> <ul style="list-style-type: none"> <li>a-1) Complete assembly, GA drawing outdoor current transformer showing plan, elevation and typical section view.</li> <li>a-2) Typical connection diagram and winding connection of current transformer.</li> <li>a-3) Secondary box details</li> <li>a-4) Structural drawing for CT mounting arrangement</li> <li>a-5) Rating plate diagram</li> <li>a-6) Drawings of terminal connectors</li> <li>b) Detailed reference list of customers already using the offered product during the last 5 years with similar design and rating.</li> <li>c) Completely filled GTP</li> <li>d) Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.</li> <li>e) Details of manufacturer's quality assurance standards and program and ISO 9000 series or equivalent national</li> </ul>
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## Volume – I Technical Specification for 66KV Outdoor CT

		<p>certification</p> <p>f) Type test report shall be submitted for the type, size &amp; rating of product / equipment offered along with bid. They shall be considered valid for 5 years from date of test performed on product / equipment.</p> <p>g) Complete product catalogue and manual along with the bid.</p> <p>h) Recommended spare parts and consumable items for 5 years of operation with prices and spare parts catalogue with list for future requirements.</p>
7.2.0	After award of contract, seller has to submit mentioned drawings for buyer's Approval (A) / Reference (R)	<p>a) Programme for production and testing (A)</p> <p>b) Guaranteed Technical Particulars (A)</p> <p>c) Calculations to substantiate choice of electrical , mechanical component size / ratings (A)</p> <p>d-1) General arrangement drawing of the current transformer (A)</p> <p>d-2) Typical connection diagram and winding connection of current Transformer (A).</p> <p>d-5) Terminal connector drawings (A)</p> <p>d-7) General arrangement drawing secondary terminal box (A)</p> <p>e) Detailed installation and commissioning instructions ( R)</p> <p>f) Quality plan</p>
7.3.0	Submittals required prior to dispatch	<p>a) Inspection and test reports, carried out in manufacturer's work (R )</p> <p>b) Test certificates of all bought out items</p> <p>c) Operation and maintenance instruction as well as trouble shooting charts / manuals.</p>
7.4.0	Drawing and document sizes	Standard size paper A0, A1 , A2, A3, A4
7.5.0	No of drgs./Documents required at different stages	As per Annexure A

## 8.0 PACKING , SHIPPING, HANDLING AND STORAGE

8.0.0	Packing	
8.1.1	Packing protection	Against corrosion , dampness, heavy rains, breakage and vibration
8.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection and identification labels.

## Volume – I Technical Specification for 66KV Outdoor CT

8.1.3	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's / supplier's its agent h) Description and quantity i) Country of origin j) Month and year of manufacturing k) Case measurements l) Gross and net weight in kilograms m) All necessary slinging and stacking instructions.
8.1.4	Shipping	a) The 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.
8.1.5	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual need to be furnished before commencement of supply.

## 9.0.0 PROGRESS REPORTING

9.1.0	Outline Document	To be submitted for purchase approval for outline of production, inspection, testing, inspection, packing, dispatch, documentation programme.
9.2.0	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 assemble (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

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**10.0.0 DEVIATIONS**

10.0.0	Deviation from the specification	Deviation from the specification shall be started 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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## Volume – I Technical Specification for 66KV Outdoor CT

### Annexure – A Scope of supply

#### 1.0 The scope of supply shall include following

- 1.1 Design, manufacture, assembly, testing at manufacturer's works before dispatch, packing, delivery and submission of all documentation of outdoor current transformer.
- 1.2 Terminal connector.
- 1.3 Supervision of testing & commissioning of current transformer at site
- 1.4 BOQ as following –

Sr no.	Purchaser Equipment Tag No / SAP code	Equipment Description	Location Substation name	Unit	Quantity
1					
2					
3					
4					
5					
6					
7					

#### 2.0 Submission of documents

Submission of drawing, calculations, manual , catalogues, test report shall be as follows

	Along with offer	For Approval after award of contract	Final after approval	Remarks
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 for the transformer	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 date 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 clearances for purchaser

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**Annexure – B SERVICE CONDITIONS**

1.0.0	Mumbai Atmospheric conditions	
a)	Average grade atmosphere	Heavy 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)	Maximum 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	Heavy polluted , dry
b)	Maximum altitude above sea level	1000 M
c)	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
d)	Maximum 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



**Volume – I Technical Specification for 66KV Outdoor CT**

**Annexure – C1: Guaranteed Technical Particulars (33KV , 800-400/1/1/1/1A)**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	33 kV							
5	Highest System Voltage	36 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	800 - 400 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.2s	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			$\approx$ 40 (RCT+8)	$\approx$ 40 (RCT+8)				
10.8	Magnetizing current at $V_k/2$ (project specific)			≤30 mA	≤30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	26.3 kA							
12	Rated dynamic current of primary								
13	Rated continuous thermal current								
14	Temp rise at an ambient of 50 deg C								
14.1	Winding								
14.2	Oil at the top								
14.3	Exposed current carrying parts								

**Volume – I Technical Specification for 66KV Outdoor CT**

15	One minute power frequency dry withstand voltage (KV rms)	70 kV rms	
16	One minute power frequency wet withstand voltage (KV rms)	70 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	170 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

**Volume – I Technical Specification for 66KV Outdoor CT**

**Annexure – C2: Guaranteed Technical Particulars (33KV, 2000-1000/1/1/1A)**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	33kV							
5	Highest System Voltage	36 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	2000-1000 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.2s	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			≥ 40 (RCT+8)	≥ 40 (RCT+8)				
10.8	Magnetizing current at Vk/2 (project specific)			≤30 mA	≤30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	26.3kA							
12	Rated dynamic current of primary								
13	Rated continuous thermal current								
14	Temp rise at an ambient of 50 deg C								
14.1	Winding								
14.2	Oil at the top								
14.3	Exposed current carrying parts								
15	One minute power frequency dry withstand voltage (KV	70 kV rms							

**Volume – I Technical Specification for 66KV Outdoor CT**

	rms)		
16	One minute power frequency wet withstand voltage (KV rms)	70 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	170 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

**Volume – I Technical Specification for 66KV Outdoor CT**  
**Annexure – D1 : Guaranteed Technical Particulars (66KV , 400-200/1/1/1/1A)**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	66kV							
5	Highest System Voltage	72.5 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	400-200 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.2s	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			≥ 40 (RCT+8)	≥ 40 (RCT+8)				
10.8	Magnetizing current at Vk/2 (project specific)			≤30 mA	≤30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	31.5kA							
12	Rated dynamic current of primary								
13	Rated continuous thermal current								
14	Temp rise at an ambient of 50 deg C								
14.1	Winding								
14.2	Oil at the top								
14.3	Exposed current carrying parts								
15	One minute power frequency dry withstand voltage (KV rms)	140 kV rms							

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16	One minute power frequency wet withstand voltage (KV rms)	140 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	325 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

**Volume – I Technical Specification for 66KV Outdoor CT**  
**Annexure – D2: Guaranteed Technical Particulars (66KV, 800-400/1/1/1/1A)**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	66kV							
5	Highest System Voltage	72.5 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	800-400 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.2s	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			≥ 40 (RCT+8)	≥ 40 (RCT+8)				
10.8	Magnetizing current at Vk/2 (project specific)			≤30 mA	≤30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	31.5kA							
12	Rated dynamic current of primary								
13	Rated continuous thermal current								
14	Temp rise at an ambient of 50 deg C								
14.1	Winding								
14.2	Oil at the top								
14.3	Exposed current carrying parts								
15	One minute power frequency dry withstand voltage (KV rms)	140 kV rms							

**Volume – I Technical Specification for 66KV Outdoor CT**

16	One minute power frequency wet withstand voltage (KV rms)	140 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	325 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		



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**Annexure – D3: Guaranteed Technical Particulars (66KV, 1600-800/1/1/1A)**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	66 kV							
5	Highest System Voltage	72.5 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	1600-800 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.2s	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			≥ 40 (RCT+8)	≥ 40 (RCT+8)				
10.8	Magnetizing current at V <sub>k</sub> /2 (project specific)			≤ 30 mA	≤ 30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	31.5 kA							
12	Rated dynamic current of primary								
13	Rated continuous thermal current								
14	Temp rise at an ambient of 50 deg C								
14.1	Winding								
14.2	Oil at the top								
14.3	Exposed current carrying parts								
15	One minute power frequency dry withstand	140 kV rms							

**Volume – I Technical Specification for 66KV Outdoor CT**

	voltage (KV rms)		
16	One minute power frequency wet withstand voltage (KV rms)	140 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	325 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

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**Annexure –D Recommended spares (Data by Supplier)**

List of recommended spares as following –

Sr. No.	Description of spare part	Unit	Quality
1			
2			
3			
4			
5			
6			

**TECHNICAL SPECIFICATION**  
**FOR**  
**OUTDOOR**  
**DISCONNECTING SWITCH**

Prepared by	Supriya Raina		Rev: 0
Reviewed by	Meenakshi		Date:
Approved by	Kiran Kumar Alla		

## Volume – I Technical Specification for Disconnecting Switch

### 1.0 CODES & STANDARDS:

Materials, equipment and methods used in the manufacture of outdoor disconnecting switch shall confirm to the latest edition of following standard: -

#### National Standard

Standard Code	Standard Description
	Indian Electricity Rules (relevant safety regulation of CEA)
	Indian Electricity Act 2003
	CBIP manual
IS : 9921 - Part I to V	Specification for Alternating Current Disconnectors (Isolators) and Earthing Switches
IS : 0996 -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 1.1 kV.
IS : 2147 -1962	Degree of protection provided by enclosure for low-voltage switchgear control gear
IS : 2544	Porcelain Post Insulator
IS : 2629 -1985	Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
IS : 6639 - 1972	Specification for Hexagon Bolts for Steel Structures

### 2.0 DESIGN FEATURES

S No	Description	Requirement / Rating
2.1.0	Disconnect Switch Type & Mechanism	Motor operated, central rotating double break with turn and twist mechanism, triple pole, outdoor type for installation and operation in horizontal plane with or without earth switches, as required complete in all respects.
2.1.1	Motor assembly	Suitable for 3 phase 415V, 50 Hz. Provided with a quick electro-mechanical brake on high speed shaft for rapid braking.
2.2.0	Earth Switch Mechanism	Manually operated
2.3.0	Disconnect Switch Controls	
2.3.1	Remote electrical control	Required
2.3.2	Local Manual control	Required
2.3.3	Local electrical control	Required from integral Local Control Cabinet
2.4.0	Interlock with circuit breakers	Electrical interlock suitable for 220 V DC
2.5.0	Interlock with Earth Switch	Mechanical & Electrical interlock
2.6.0	Padlock for Earth Switch	Padlock & keys for both positions i.e. when earth switch is grounded and when earth switch is un-grounded.
2.7.0	Fixed Contacts	
2.7.1	Type of contacts	Spring loaded with smooth surface, silver plated

## Volume – I Technical Specification for Disconnecting Switch

2.7.2	Current carrying castings	Non corrodible, non ferrous material
2.7.3	Current carrying Springs	Made of non aging, non magnetic stainless steel with life long spring action strength
2.8.0	Insulators	
2.8.1	Construction	Comprising of cylindrical solid core post insulators. The porcelain used in the insulators shall be homogeneous, free from laminations, cavities or any other defect which may affect its mechanical and dielectric qualities and shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown colour, free from blisters, burrs and other defects.
2.8.2	Fasteners	All metal caps, jointing flanges, bolts and nuts shall be made of high grade cast iron or malleable steel casting, machine faced and hot-dip galvanized.
2.9.0	Moving Contacts	
2.9.1	Type of contacts	High pressure relieving copper contacts, silver plated
2.9.2	Wiping Action	Required during opening & closing. Shall be adequate to remove any oxide film formed without causing scouring or abrasion on the contact surfaces.
2.10.0	Current carrying Springs	Made of non aging, non magnetic stainless steel with life long spring action strength
2.11.0	Fault Current rating	Earth switch shall be able to carry same Fault Current as assigned to the disconnecting switch.
2.12.0	Disconnecting Switch contacts movement	90 deg from full open to full close in order to ensure a distinct break and clear visibility.
2.13.0	Corona Effect	Shall be free from visible corona discharge in both open & close positions at visible discharge test voltages.
2.14.0	Control cabinet	
2.14.1	Enclosure	Weather-proof, water-shedding, corrosion-proof IP-55 steel cabinet
2.14.2	Cabinet Door	Neoprene Gasketed, hinged access door shall have a mechanical indicator fitted to clearly indicate fully opened and fully closed positions of the disconnection switch.
2.14.3	Wiring	Control wiring shall be done using 1.1KV grade 2.5 sq.mm stranded copper conductor, PVC insulated, cables laid in GI conduits.
2.14.4	Locking arrangement	Padlocking arrangement to be provided.
2.14.5	Incomer	A local TPN MCB to be provided in cabinet at power supply incoming point.
2.14.6	Outgoing Control Wiring	All outgoing control wiring shall terminate on terminal blocks, inside the cabinet so as to have maximum access to all conductor terminals.
2.14.7	Aux. Contacts	All auxiliary contacts of the disconnection switch and earthing switches shall be supplied duly wired up to the terminal blocks.
2.14.8	Terminals	Stud type terminals with at least twenty (20) percent spare terminals shall be provided over and above the number actually required.
2.14.9	Paint Shade	Polyurethane Paint Shade no. 692 of IS-5.

**Volume – I Technical Specification for Disconnecting Switch**

2.14.10	Local Controls	A local/ remote changeover switch shall be fitted inside the cabinet together with open/ close push buttons for local control.
2.15.0	Manual Operation	Manual operation of disconnection switch by means of crank handle disconnecting power supply to the 3-pole operating mechanism on insertion into its socket. The height of socket shall be about 1.2 meter above the finished ground level of the substation.
2.16.0	Disconnection switches with Earth switch	Switch shall have three (3) grounding blades forming integral part of the isolator. These blades shall be capable of being fitted on either side of the blades. Flexible heavily tinned copper braids of adequate cross-sectional area with connector suitable for the specified short circuit current shall be provided on the hinged end of the grounding blade for connection to the station grounding grid.
2.17.0	Grounding Blades Operation	Manually operated and interlocked with disconnection switch so that the grounding blades can be closed only when the disconnection switch is open.
2.18.0	Pivot bearings	Shall be maintenance-free and corrosion resistant. Double tapered-roller bearings located 150 mm apart suitable for ensuring smooth and dependable operation of the disconnection switch shall be located at the base of the supporting insulators. The earthing switch shaft shall also be provided with necessary bearings. The bearings shall be suitable for effective operation of disconnection switch and earthing switches even after long periods of their remaining in closed/ open position.
2.19.0	Disconnection Switch Poles & base	Each pole of the disconnection switch shall be provided with a complete galvanized steel base designed for mounting on a supporting structure/ gantry. The base shall be rigid and self-supporting and shall require no guying or cross bracing between phases. The group operated isolators shall have a common supporting structure for all the three (3) poles.
2.20.0	Grounding Pads	Each pole of disconnection switch shall be provided with two (2) grounding pads of non-corrodible material brazed to the channel base at opposite ends. Flexible tinned copper (15-25 microns) connectors shall be provided for a) Connection of earthing pad of each pole, b) Operating handle, c) Earthing switches.
2.21.0	Counter-Balancing Springs/ Weights	Springs/ weights of non-rusting alloy composition shall be provided for counter-balancing the earthing switch blades to prevent impact at the end of travel both on opening and closing of the earthing switch.
2.22.0	Name Plates	Corrosion-proof nameplates giving all the relevant mandatory as well as optional information as stipulated in IS shall be provided on disconnection switches, earthing switches and operating devices as per the Owner's/ Consulting Engineer's approval.

## Volume – I Technical Specification for Disconnecting Switch

### 3.0 APPROVED MAKE OF COMPONENTS

3.1.0	Motors	ABB / Siemens / Crompton
3.2.0	Insulators	JSI / WSI / Modern / BHEL/CJI
3.3.0	Switch	Kaycee / L&T (Salzer)
3.4.0	HRC Fuse Links	Alstom / Siemens / L&T
3.5.0	AC Contactors & O/L Relay	L&T / Siemens / Schneider
3.6.0	Terminals	Connectwell / Elmex
3.7.0	Push buttons / Actuator	L&T / Teknic / Siemens
3.8.0	MCB	Merlin Gerin / Siemens / Schneider

### 4.0 TESTING & INSPECTION

4.1.0	Internal Test	Manufacturer shall carry out comprehensive inspection and testing during manufacturing of the equipment.
4.2.0	Type test	The product must be of type tested quality. Type test reports shall be submitted for the type, size & rating of equipment offered along with bid. If the manufacturer's lab is accredited by govt./ authorized body then it shall be acceptable for type testing.
4.3.0	Routine test	As per relevant IS / IEC.
4.4.0	Acceptance test	As per relevant IS / IEC.
4.5.0	Test Witness	
4.5.1		The Buyer reserves the right to witness all tests specified on completed product.
4.5.2		The Buyer reserves the right to inspect the product at the Sellers works at any time prior to dispatch, to verify compliance with the specifications.
4.5.3		In-process and final inspection call intimation shall be given in advance to Owner.
4.6.0	Tests on fitting and Accessories	As per Manufacturer's Standards and relevant IS / IEC.

### 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

**SUPPLY OF MATERIAL AND ERECTION, TESTING & COMMISSIONING  
FOR**

**66 KV MONOPOLE**

**Specification No.: GN101-03-SP-171-00**

Prepared by		Checked by		Approved by		Rev	Date
Name	Sign	Name	Sign	Name	Sign		
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## **SECTION-1 GENERAL REQUIREMENT**

### **1.0 SCOPE OF WORK:**

The scope covers the requirement of Supply, Erection, Testing and Commissioning of 66 kV Multi Circuit Line Monopole with associated works including supply of all equipment/ materials. Detailed scope shall be as below:

1. Route Survey, Profiling and Monopole spotting and submission of detailed drawing.
2. IIT validation of Design calculation of Monopole and its Foundation.
3. Design, manufacture, testing at manufacturer's works (before dispatch), supply of Monopoles and its associated accessories as specified.
4. Supply of Other Line items/ Accessories such as ACSR Goat, Insulator strings, vibration dampers, hardwares, earthing material, earth wire with accessories etc. Bidder shall supply this material from BRPL approved vendors.
5. Erection of supplied steel tubular transmission monopoles (including civil work) along with all related accessories as per the approved Monopole spotting/ alignment.
6. Erection of other Line items/ accessories such as ACSR Goat, Insulator strings, vibration dampers, hardwares, earthing material, earth wire with accessories etc.
7. Provision of Earthing of monopole and earth wire.
8. Testing and commissioning of 66 kV lines on rated voltage.
9. Dismantling of existing Tower line structure and transport to scrap store of BRPL.

Any item, which may not have been mentioned herein, but necessary for the satisfactory operation of the above items shall be deemed to be part of the requirements. The material shall have all essential features prescribed in relevant IS/International or equivalent Standards referred in this specification.

### **2.0 STANDARDS:**

#### **Indian Standards**

IS 5613- for determining the clearance diagrams for the pole  
IS 802 - for sag tension and loading calculation  
IS 875- CEA Safety Regulation 2010

#### **ASTM – American Society for Testing and Materials**

A 36 / 36 M Standard Specification for Structural Steel, Book 01.04  
A 123. Specification for Zinc (Hot-Dip Galvanized) Coatings on iron and Steel Products, Book 01.06, 15.08.  
A 153. Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Book 01.06.15.08.  
A 572/572M Specification for High-Strength Low Alloy Columbium Vanadium Steels of Structural Quality.  
A 780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

#### **AWS – American Welding Society**

D1.1-92 Structural Welding Code – Steel. Specification for Carbon Steel Covered Arc- Welding Electrodes.  
A5.17-89. Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc- Welding

**ASCE – American Society of Civil Engineers**

ASCE SEI 48-05 - Design of Steel Transmission Pole Structures.

**ISO – International Standards Organization**

ISO 9001. Quality System Model for Quality Assurance in Design/Development, Manufacture and Testing.

ISO 9002. Quality System Model for Quality Assurance in Production, Installation and Servicing.

**Full scale testing**

IEC 60652 – 2002

These codes and standards set forth the minimum requirements which may be exceeded by Contractor if, in Contractor's judgment and with PURCHASERS acceptance, superior designs and materials are available

for successful and continuous operation of equipment as required by this specification.

**3.0 ATMOSPHERIC CONDITIONS:**

S. No.	Particulars	Data
1	Average Grade of Atmosphere	Heavily Polluted, Dry
2	Maximum Altitude above Sea Level	1000 M
3	Ambient Temperature	Max. 50 Deg. C, Min. 0 Deg. C Average 40 Deg. C
4	Relative Humidity	100%
5	Seismic Zone	4
6	Rain Fall	750 mm concentrated in four months

**4.0 Electrical System Data:**

S. No.	Particulars	Data
1	Nominal Voltage	66 kV
2	Highest System Voltage	72.5 kV
3	Power Frequency Withstand Voltage	170 kV rms
4	Basic Insulation Level (Impulse)	350 kV peak
5	Short Circuit Level	40 kA for 3 Sec.
6	Nominal Frequency	50 Hz

**5.0 CIRCUIT DETAILS:**

S. No.	Particulars	Data
1	Name of the circuit	66 kV Line
2	Circuit Configuration	Multi Circuit, Vertical Configuration
3	Conductor	ACSR Goat
4	No. of Conductors	3-phase per circuit, One conductor per phase
5	Earth Wire	One 7/3.15 mm

6	Shielding Angle	$\leq 30$ degree
7	Minimum Ground Clearance	7.4 M
8	Nominal Span	200 M
9	Basic Wind Speed	47/Sec. as per IS – 875 Part – 3

## 6.0 TESTING AND INSPECTION:

All routine & acceptance tests shall be witnessed by the purchaser/his authorized representative.

### 6.1 Routine Test:

The bidder shall provide material wise routine test report conducted at, their work along with the standards application in their bid.

### 6.2 Acceptance tests:

Acceptance test shall be carried out as per technical specification and relevant standard. Following compulsory acceptance test shall be carried out on all items before the supply of material:

- a) Visual Inspection
- b) Physical verification
- c) Dimensional checks

### 6.3 TYPE TEST CERTIFICATES

The bidder shall furnish the type test certificates from CPRI/ERDA for Monopoles, as per relevant standards and specification.

The bidder shall furnish the type test certificates from CPRI/ERDA/NABL for ACSR Goat, Earth wires, Insulators and All hardware fittings and other accessories as per relevant standards and Technical specification.

Type tests should have been conducted in certified Test laboratories not exceeding 5 years from the date of opening the bid, In the event of any discrepancy In the test reports, i.e. any test report not acceptable, same shall be carried out without any cost implication to the Purchaser.

## 7.0 DRAWINGS, DATA & MANUALS

7.1	Documents	copy of signed documents also shall be part of entire soft file (e-file) or CD.)
7.2	Along with the Bid	Vendor shall submit signed 3 sets (plus 1 set of soft copy) of following documents: a) GTP (duly filled-in) (as per Annexure - A). b) Cross-sectional drawings for components Assembly c) Type Test Certificates d) Complete Catalogue and Instructions. e) Any other document.
7.3	After Award of Contract	Vendor shall submit signed 2 sets (plus 1 set of soft copy) of above mentioned documents within 15 days, for Purchaser's approval.
7.4	"As-Built" documents	Final signed "As-built" documents for the equipment in 3 sets (hardcopy), 1 no. soft copy and 1 no. CD. These documents shall include signed Routine & Acceptance Test Certificates also.

7.5	Packing, Marking, Shipping, Handling and Storage	Every component/kit/box shall be properly sealed/ packed for protection against damage.
7.6	Transit damage	The seller shall be responsible for any transit damage due to improper packing.

## **8.0 Quality Assurance (QA)**

8.1	Vendor's Quality Plan (QP)	To be submitted for Purchaser's approval as well along the bid.
8.2	Sampling Method	Sampling Method for quality checks shall be as per manufacturer's standard practice / ESI guidelines and Purchaser's prior approval shall be taken for the same.
8.3	Inspection Hold-Points	To be mutually identified, agreed and approved in Quality Plan.

## **9.0 Deviations**

9.1	Deviations	<p>A) Deviations from this specification can be acceptable, only where the Seller has listed in his quotation the requirements he cannot, or does not, wish to comply with and which deviations the Buyer has agreed to in writing, before any order is placed.</p> <p>B) In the absence of any list of deviations from the Seller, it will be assumed by the Buyer that the Seller complies with the Specification fully</p>
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## **SECTION-2**

### **TECHNICAL SPECIFICATION OF MONOPOLE**

#### **1.0 SCOPE**

The designs of multi circuit and Multi circuit steel monopole towers and their extensions should be conforming to the design parameter specified herein. The scope of supply of towers also includes supply of design calculations and test reports for towers and extensions including detailed structural/shop drawings of towers, extensions and stub-setting templates and design and drawings of foundations in various types of soil, sag templates, sag tension chart for conductor and ground wire etc.

The fabricated steel poles shall include base plate with its required accessories, monopole body (including extensions, if required), Cross Arms. Monopole shall be joined with friction clip or Flanged joint. Cross Arms shall be also Polygonal with structural jointing arrangement. The accessories shall include strain plates, D-shackles with nuts, bolts and washers, U-Bolts with nuts and washers, space washers, links for providing attachment to the Earth Wire and Conductor, anticlimbing devices and any other equipment/ material / article to complete the works as per the scope given in this specification.

The monopoles shall be fully galvanized. Provision will be made at the Cross Arm level for fixing phase plates and Bird guards. The holes for fixing the Earthing bonds at the peak and for grounding the monopoles at bottom or any other holes, which the purchaser may require, shall be provided at the convenient locations on the monopoles.

#### **2.0 TYPE OF MULTI CIRCUIT STEEL MONOPOLE**

The multi circuit monopole will have four circuits (twelve cross arms), self-supporting, designed for the specified loading conditions. There will generally be following type of towers:-

Monopole type MP0: Tangent type tower with maximum line deviation up to 2° to be used with Single/ Double suspension insulator strings.

Monopole type MP30: Medium angle tower to be used for line deviation from 2° to 30° with Single/Double tension insulator strings.

Monopole type MP60: Heavy angle tower to be used for line deviation from 30° to 60° and also as dead end tower with Single/Double tension insulator strings.

The multi circuit Monopole will have min four circuits (twelve cross arms), self-supporting, designed for the specified loading conditions. There will generally be following type of towers:-

Monopole type MP0: Tangent type tower with maximum line deviation up to 2° to be used with Single/Double suspension insulator strings.

Monopole type MP30: Medium angle tower to be used for line deviation from 2° to 30° with Single/Double tension insulator strings.

Monopole type MP60: Heavy angle tower to be used for line deviation from 30° to 60° and also as dead end tower with Single/Double tension insulator strings.

The bidder may also quote for upgradation work using the categories of Monopole available with him. In such case the bidder will have to indicate the type of monopoles and extensions proposed to be used by him for upgradation work.

**3.0 EXTENSIONS**

Suitable extension of 3M, 6M, 9M & 12M height shall be designed for use with all type of towers (If required and as mentioned in BOQ).

**DESIGN: 66KV as per ASCE-48-05**

The bidder will furnish a design as per ASCE-48-05 for each of the offered monopoles with extensions based on the loading conditions indicated herein. The suspension monopoles shall be designed with using 'I' suspension string.

Please note that in case of suspension monopole, full wind condition is to be considered in the design in case of security requirement i.e. transverse load due to wind action on tower structure, conductors, ground wire and insulators shall be computed as per clause 12.1.1(i), page 10 of IS 802 (Part-1) 1995 or its latest. The mechanical tension of conductor/ground wire is the tension corresponding to 100% design wind pressure at everyday temperature or 36% design wind pressure at minimum temperature after accounting for drag coefficient and gust response factor as defined in clause 11.3.2.1 page 10 of IS 802 (Part-1) 1995 or its latest. The longitudinal loads shall correspond to 50% of mechanical tension of conductor as per clause 11.3.2.1, page 10 of IS 802 (Part-1):1995 or its latest.

The monopole will have one conductor per phase (Goat ACSR) in vertical formation and one ground-wire of (7/3.15mm) galvanized stranded steel wire of 95kg/sq.mm grade placed on the top of the monopole. The conductor and ground-wire particulars are given in following sections.

The ground-wire at its suspension point shall provide a shielding angle of 30° with respect to the top most conductors. The drop of ground-wire suspension assembly should be taken into account so as to determine the shielding angle.

The minimum mid-span vertical clearance between Ground-wire and Conductor in still air shall be 7.4 Mtrs for 66 KV. The minimum electrical clearance between conductors shall be 2.3 Mtrs for 66KV (Horizontal) for 66KV tower.

ACSR Goat and ground wire data shall be as below:

<b>Parameters</b>	<b>ACSR Goat Conductor</b>	<b>Ground wire:</b>
Stranding and wire diameter	30/3.71 mm Al. + 7/3.71 mm Steel	7/3.15mm Steel
Total sectional area	399.6 sq. mm	54.55 mm <sup>2</sup>
Approximate overall diameter	26 mm	9.54 mm
Approximate weight	1492.4Kg/Km	428 kg/km
Approximate calculated breaking load	89.67 kN	5810 kg
Co-efficient of linear expansion	$18.43 \times 10^{-6}$ per degree C	$11.50 \times 10^{-6}$ per deg. C.

**4.0 CLEARANCES:**



The following minimum clearances may be made available between the live parts and the nearest Monopole bay.

Suspension string Jumper in case of tension monopoles Swing Clearance:

S. No.	Description	Swing Clearance ( mm)
1	Still Air (Nil)	2130
2	15 deg	1980
3	30 deg	1830
4	45 deg	1675

The above clearances are based on maximum and minimum string lengths of insulators as per standard practice. If Pilot string is used in case of 60° monopole; swing of the pilot string shall be 15 deg. The clearance shall be available from grading ring if the same happens to be the nearest to the monopole body at any point of time.

#### **5.0 DESIGN SPANS:**

The wind span for the purpose of computing the wind load on conductors and ground-wire shall be indicated in the offer. Similarly the weight span shall also be indicated.

#### **6.0 WIND LOAD:**

The wind load on conductors, earth wire, towers and insulator strings shall be taken as per recommendations of IS: 802 (Part-I) -1995 or its latest with latest revision thereof, for following conditions:-

- a. Wind zone - 4 (Six) (47mtrs/sec)
- b. Reliability level –
  - i. 1.0 (one) for Double circuit monopoles
  - ii. 2.0 (Two) for Multi circuit monopoles.
- c. Terrain category - 1 (one)

#### **7.0 TEMPERATURE VARIATION:**

The maximum working tension of conductor and ground-wire and the uplift conditions shall correspond to the minimum temperature of 0° C. The maximum conductor sag and ground clearance beneath should correspond to the maximum working temperature of 75° C. The Maximum ground-wire temperature shall be taken as 53°C.

#### **8.0 STRUCTURAL STEEL:**

Structural steel shall be conforming to IS: 2062 Grade E-355 JR and weld able quality and plates less than 6mm thickness (to be used for pack plate and pack washer) shall be as per IS: 1079.

Permissible stresses in the design of self-supporting steel monopole tower shall conform to ASCE: 48-05 latest edition or equivalent code of latest edition. The sheets/plates of monopole shall be from TATA/SAIL/JSW/ESSAR.

## **9.0 LOADS ON MONOPOLES:**

Transmission lines are subjected to various loads during their life time. These loads are classified into three distinct categories, namely

- a) Climatic Loads: related to the reliability requirements.
- b) Failure containment Loads: related to security requirements.
- c) Construction & Maintenance Loads: related to safety requirements.

### **a) Climatic Loads:**

These are random loads imposed on monopole, insulator string; conductor & ground wire due to action of wind on transmission line & do not act continuously. Climatic loads shall be determined under either of the following climatic conditions whichever is more stringent:

- (1) 100 percent design wind pressure at every day temperature (32°C) **or**
- (2) 36 percent design wind pressure at minimum temperature (0°C)

### **b) Failure Containment Loads:**

Anti-cascading Loads & Torsional & Longitudinal Loads

#### **i) Anti-Cascading Loads:**

Cascade failure may be caused by failure of items such as insulators, hardware, joints failures of major components such as monopoles, foundations, conductor due to defective material or Workman ship or from climatic overloads sometimes from casual events such as misdirected aircraft, avalanches, sabotage etc. The security measures adopted for containing cascade failures in the line is to provide angle monopoles at specific intervals which shall be checked for Anti-cascading loads.

#### **ii) Anti-cascading checks:**

- 1. Suspension monopoles shall be checked for narrow front wind with a wind speed of 2.0 of basic wind speed.
- 2. Angle monopoles shall be checked for the following anti cascading conditions with all the conductors & ground wire intact only on one side of the monopole.

**Transverse load:** These loads shall be taken under no wind condition.

**Vertical Load:** These loads shall be the sum of weight of conductor/ground wire as per weight span of intact conductor/ground wire, weight of insulator strings and accessories.

**Longitudinal Loads:** These loads shall be the pull of conductor/ground wire at every day temperature & no wind applied simultaneously at all points on one side with zero degree line deviation.

### **Torsional & Longitudinal Loads:**

These loads are caused by breakage of conductors and/or ground wire. All the monopoles shall be designed for these loads for the number of conductor(s) and or ground wire considered broken as per provisions of this specification.

### **c) Construction & Maintenance Loads:**

These are loads that are imposed on monopoles during constructions & maintenance of transmission lines.

Computation of Loads & loading combinations: The computation of loads is to be done in line with relevant provisions/ sections of IS 802- 1992 (latest amendment)

#### **Tension Limits:**

Conductor/ground wire tension at everyday temperature & without external load, should not exceed the following percentage of the ultimate tensile strength of the conductor:

Initial unloaded tension **22 percent**, Final unloaded tension **25 percent** provided that the ultimate tension under everyday temperature & **100 percent** design wind pressure or minimum temperature & **36 percent** design wind pressure does not exceed **70 percent** of the ultimate tensile strength of the conductor/ground wire.

#### **TRANSVERSE LOADS**

The transverse loads due to wind on conductors and ground-wire shall be calculated

- (i) The normal span for normal Multi-circuit monopoles (i.e. upto +6m Extension) shall be 200m
- (ii) The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equal to normal ruling span.
- (iii) The weight span shall be shown in the design report of monopoles. The horizontal distance between the lowest point of the conductors on the two spans adjacent to the tower. The weight spans considered for design of monopoles is as below.

under normal condition.

Under broken wire conditions 50% of the intact span and 10% of the broken span shall be assumed as wind span. In addition to this, transverse loads due to line deviation, wind on towers, and wind on insulator strings should also have to be taken into consideration in the design of the towers.

#### **CONDUCTOR AND GROUND-WIRE SAG:**

The maximum sag for the conductor should be calculated for 75° C and no wind with an allowance of 3% of maximum sag to allow for plotting and sagging errors.

#### **GROUND CLEARANCE:**

The minimum ground clearance of **7.4Meters** shall be available corresponding to the maximum working temperature and normal span.

#### **BROKEN WIRE CONDITIONS:**

Following broken wire conditions should be assumed in the design of towers:-

**a. Suspension monopole- Any one** of power conductor broken or ground-wire broken which ever condition is more stringent for design.

**b. Angle Monopole** for 2° to 30° deviation - Any two of power conductors broken on the same side and on the same span or any one of the power conductor broken and ground-wire broken on the same span whichever combination constitutes the most stringent condition for design of a particular member.

c. **Angle Monopole** for 30° to 60° deviation - Any Three power conductors broken on the same side and on the same span or any two of the power conductor broken and ground-wire broken on the same side and same span whichever combination constitutes the most stringent condition for design. Further this monopole shall also be designed for dead end condition i.e. all conductors and ground wire broken on the same side and same span.

In all type of monopoles, the power conductor's supports and ground-wire supports should be designed for broken wire conditions also.

#### **FACTORS OF SAFETY FOR MONOPOLES:**

The factors of safety for design of monopoles shall be as under:-

- (i) Normal condition – **1.5**.
- (ii) Broken wire condition – **1.5**

**DEFLECTION CRITERIA:** 1.5% of the height under safety normal condition and 5% of height under ultimate wind for both suspension and tension poles.

#### **BOLTS AND NUTS AND WASHERS:**

The design of the monopoles should be based on use of HRH mild steel hot dip galvanized bolts having grade 6.8(for foundation bolts)/8.8(for connection bolts). The connections shall be designed on the basis of use of 24 mm dia bolts. The spring washers shall be provided for insertion under all nuts. These washers shall be of steel, electro galvanized, and positive lock type and of minimum 3.5mm thickness.

The nuts shall be forged and tapped after galvanizing and then lubricated. The nuts shall be chamfered on one face only, the other face shall be machined.

The bolts and nuts shall be free from forging and threading defects such as cuts, splits, burrs, bulging, taper, eccentricity, loose fit etc.

The bolts shall be threaded up to standard length only as per relevant Indian Standard and not to full length.

The bolts and nuts shall confirm to IS 1367-1971 Part-III and Part-IV, IS 12427, IS 1363-92, IS 1367 Part-XIII with latest amendment.

The spring washers after coiling shall be suitably heat treated so as to result in the finished washer having hardness 43 to 50 HRC when tested in accordance with IS 1586- 1968.

The surface of the washers shall be free of scales and burrs. The washers shall be coiled without any kinks (except for the shape with turned-up ends). The ends of the washer shall not about when the washers are compressed. The ends shall be so served as to prevent tangling.

#### **LOAD ON FOUNDATIONS:**

The foundations shall withstand the ultimate loads on the superstructure as specified in this specification, for the full footing reactions along the stub angle slopes obtained from the structural stress analysis.

The reactions on the footing shall be composed of the following types of loads for which they shall be required to be checked.

- (a) Maximum tension or uplift.
- (b) Maximum compression or down-thrust.
- (c) Maximum horizontal shear or side thrust.

The additional weight of concrete in the footing below ground level over the earth weight and full weight of concrete above the ground level in the footing and embedded steel parts will also be taken into account adding to the down-thrust.

#### **STABILITY ANALYSIS:**

The following primary types of soil resistances shall be assumed to act in resisting the loads imposed on the footings in earth:

##### **(a) Resistance against uplift:**

The uplift loads will be assumed to be resisted by weight of earth in an inverted frustum of a conical pyramid of earth on the footings pad whose sides make an angle equal to the angle of repose of the earth with the vertical in average soil. The weight of concrete embedded in earth and that above the ground will also be considered for resisting the uplift. In case where the frustum of earth pyramids of two adjoining legs super-impose each other, the earth frustum will be assumed truncated by a vertical plane passing through the centre line of the tower base.

##### **(b) Resistance against down-thrust:**

The down -thrust loads combined with the additional weight of concrete above earth will be resisted by bearing strength of the soil assumed to be acting on the total area of the bottom of the footings.

##### **(c) Resistance against side thrust:**

The bidder shall describe in detail the methods followed by them to check the stability of foundations for horizontal shears.

#### **OR**

Side-thrust along with the relevant reference (**IS or other standard**) in support of their contentions.

In addition to the strength design, stability analysis of the foundation shall be done to check the possibility of failure by over-turning, uprooting, sliding and tilting of the foundation.

#### **DESIGN OF FOUNDATIONS:**

The bidder is requested to submit the design of foundations. It is recommended to give Single Pile Foundation.

**FACTORS OF SAFETY FOR FOUNDATION:**

The minimum factors of safety/overload factor based on the ultimate strength of the foundation material when the monopoles are under full working loads under various conditions of loadings combined with the other loads specified for the foundations shall be as given below:-

- (a) Normal condition - 1.5
- (b) Broken wire condition - 1.5

**TYPE TEST:**

Monopoles are to be type tested as per relevant standards.

Manufacturer/supplier shall possess valid Type test reports of (suspension & angle monopoles) from CPRI/ERDA for 66 KV or higher voltage grade monopole and conducted during last 5 years from the date of submission of drawings for approval subject to submission of report for verification.

### **SECTION-3**

#### **TECHNICAL SPECIFICATIONS OF ACSR CONDUCTOR**

##### **1.0 SCOPE**

- 1.1 This specification covers the design, manufacture, testing at manufacturer's works, packing and delivery at site of the ACSR conductor along with necessary accessories.
- 1.2 The conductor and its accessories shall be complete with all fittings and components necessary for the effective working and efficient performance and satisfactory maintenance under the various operating conditions specified. All such parts shall be deemed to be included within the scope of supply where specifically included or not in this specification in the tender schedule. The successful bidder shall not be eligible for any extra charge for such accessories.

##### **2. CODES AND STANDARDS**

- 2.1 All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard, IEC standard and CBIP manuals enlisted in the appendix 1, except where modified and / or supplemented by this specification.
- 2.2 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case copies of English version of the standard adopted shall be submitted by the vendor with the offer.
- 2.3 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.
- 2.4 The equipment offered shall in general comply with the latest issues including amendments of the standards enlisted in the appendix 1 but not restricted to it.

##### **3. DESIGN**

###### **3.1 General**

- 3.1.1 All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.
- 3.1.2 The finished material shall have minimum brittleness, as it will be subjected to appreciable vibration while in use.
- 3.1.3 The steel strands shall be hot dip galvanized and shall have a maximum zinc coating of 240gms/sqm. after stranding. The zinc coating shall be smooth, continuous of uniform thickness, free from imperfections and shall withstand three and a half dips after stranding in standard Preece test. The steel wire rod shall be of such quality and purity that, when drawn to

the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristic as prescribed in relevant ASTM/IS/IEC standards.

- 3.1.4 To avoid susceptibility towards wet storage stains (while rust), the finished material shall be provided with a protective coating of boiled linseed oil.
- 3.1.5 The finished conductor shall have a smooth surface without any surface cuts, abrasions, scuff marks and shall be free from dirt, grit etc.
- 3.1.6 The Steel wire shall be made from materials produced either by the acid or basic Open Hearth process or by electric process. No steel wire drawn from 'Bessemer Process' shall be used. The steel wire shall not contain sulphur or phosphorous exceeding 0.5% and the total of sulphur and phosphorous shall not exceed 0.085%.
- 3.1.7 The steel strands shall be performed and post formed in order to prevent spreading of strands in the event of cutting of composite core wire. Care shall be taken to avoid damages to galvanization during performing and post forming operations.

### **3.2 MATERIALS**

- 3.2.1 The aluminum strands shall be hard drawn from electrolytic aluminum rods having a purity of not less than 99.5% and a copper content not exceeding 0.04%.
- 3.2.2 The steel wire strands shall be drawn from high carbon steel wire rods produced by either the acid or basic open hearth process, the electric furnace process, or the basic oxygen process and shall conform to the following requirements as to the chemical composition:

Element	% composition
Carbon	0.50 to 0.85
Manganese	0.50 to 1.10
Phosphorus	Not more than 0.035
Sulphur	Not more than 0.045
Silicon	0.10 to 0.35

- 3.2.3 The zinc used in galvanizing shall be electrolytic high grade zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS/IEC.

### **3.3 STANDARD LENGTH**

- 3.3.1 The standard length of the conductor shall be 3000 meters. A tolerance of +/-5% on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.
- 3.3.2 Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of such random length shall not be more than 10% of the total quantity ordered. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all the above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard lengths as specified.



3.3.3 Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. The employer reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the pendency of the Contract.

### **3.4 JOINT IN WIRES**

#### **3.4.1 Aluminium wires**

No joints shall be permitted in the individual wires in the outer most layer of the finished conductor. However, joints in the 12 wire and 18 wire inner layer of the conductor shall be allowed but these joints shall be made by cold pressure butt welding and shall be such that no such way joints are within 15 meters of each other in the complete stranded conductor. The joints shall withstand a stress of not less than the breaking strength of individual strand guaranteed.

#### **3.4.2 Steel Wires**

There shall be no joint of any kind in the finished wire entering into manufacture of the strand nor strand joint or strand splices in any length of the complete stranded steel core of the conductor.

## **4 TESTS**

The following acceptance and routine tests and tests during manufacture shall be carried out on the conductor. For the purpose of this clause, the following shall apply

- i. Acceptance tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purpose of acceptance of that lot.
- ii. Routine tests shall mean those tests, which are to be carried out on each strand/spool/length of the conductor to check requirements which are likely to vary during production.
- iii. Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture to ensure the desired quality of the end product.
- iv. For all acceptance tests, the acceptance values shall be the values shall be the values guaranteed by the Bidder in the guaranteed technical particulars of his proposal or the acceptance value specified in this Specification, whichever is more stringent for that particular test.

### **4.1 TYPE TESTS**

All Type test certificate as per relevant IS/IEC shall be submitted for purchaser review. In case type tests have not been conducted earlier the same has to be carried out without any cost implication to purchaser. Purchaser has the right of witnessing any of the tests for which the supplier has to give prior notice before the date of conducting such tests. The unit rates for each type of the tests to be carried out shall be indicated in the offer. Requirement of type test shall be as listed below. Type test charges shall not be included as part of main price to be indicated in the offer.

The following tests shall be performed on a typical length of conductor. The cost of these tests shall be quoted separately.

- a) Surface condition test
- b) Test for ultimate breaking load on stranded conductor
- c) Stress strain test
- d) Measurement of diameter of individual aluminium and steel wires.
- e) Measurement of lay ratio.
- f) Breaking load of individual wires
- g) Ductility test
- h) Wrapping test
- i) Resistance test and
- j) Galvanizing test

#### **4.2 ACCEPTANCE TESTS**

- a) Visual and dimensional check by drum
- b) Visual check for joints scratches etc and lengths of conductor by rewinding
- c) Dimensional check on steel and Aluminium strands
- d) Galvanizing test on steel strands
- e) Torsion and elongation test on steel strands
- f) Check for lay ratio of various layers
- g) Breaking load test on steel and aluminium strands
- h) Wrap test on steel and aluminum strands
- i) DC resistance test on aluminium strands
- j) UTS Test on welded joint of strands

All above tests except (j) shall be carried out on aluminium and steel strands after stranding only.

#### **4.3 ROUTINE TESTS**

- a) Check to ensure that the joints are as per Specification.
- b) Check that there are no cuts, fins etc on the strands.
- c) Check that drums as per Specification.
- d) All acceptance test as mentioned above to be carried out on each coil

#### **4.4 TEST REPORTS**

- a) Records of routine tests reports shall be maintained by the Manufacturer at his works for periodic inspection by the purchaser's representative.
- b) Test Certificates of tests during manufacture shall be maintained by the manufacturer. These shall be produced for verification as and when desired by the purchaser.

#### **5. Drum Identification:**

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- i. Contract/Award letter number
- ii. Name and address of consignee
- iii. Manufacturer's name and address

- iv. Drum number.
- v. Size of conductor
- vi. Length of conductor in meters
- vii. Gross weight of drum with conductor
- viii. Weight of drum without lagging
- ix. Weight of empty drum with lagging
- x. Barrel diameter at three locations is an arrow marking at the location of measurement.
- xi. Number of turns in the outer most layer
- xii. Arrow marking for unwinding
- xiii. Position of the conductor ends
- xiv. Distance between outer most layer of Conductor and the inner surface of lagging.

### **LIST OF APPLICABLE CODES AND STANDARDS**

The conductor and earthwire shall conform to the following Indian/International Standards, which mean latest revisions amendments/changes adopted and published, unless otherwise specified here in before, International and internationally recognized standards to which these standard generally corresponding are also listed below:

<b>Sl. No,</b>	<b>Indian Standard</b>	<b>Title</b>
1.	IS: 209-1992	Zinc Ingot - Specification
2.	IS 398-1982 Part I, II, III and IV	Specification for Aluminium Conductors for overhead Transmission purposes
4.	IS: 1778-1980	Reels and drums for bare conductors
5.	IS: 2629-1985	Recommended practice for hot dip galvanizing of iron and steel
7.	IS:2633-1992	Method of Testing Uniformity of coating or zinc coated articles
8.	IS: 4826-1979	Galvanized coating on round steel wires.
9	IS: 6745-1990	Methods of determination of weight of zinc coating of zinc coated iron and
10.	BS: 433-1969	
11.	ISO/R89-1959	
12.	BS: 1559-1949	
13.	BS: 3436-1986	
14.	IEC: 1089	
15.	BS: 215-1970	
16.	ASTM A472-729	
17.	IS:7098 Part –I-1988	XLPE Insulation

## DATA SHEET OF CLIENT REQUIREMENT

### 3. DETAILS OF CONDUCTOR - GOAT

3.1 The conductor shall be ACSR 'Goat' and the details of the conductor are tabulated below:

a)	Stranding and wire diameter :	30/3.71 mm Al. + 7/3.71 mm Steel
b)	Number of strands	
	Core	: 1
	1st layer	: 6
	2 <sup>nd</sup> layer	: 12
	3 <sup>rd</sup> layer	: 18
c)	Sectional area of aluminium	: 316.5 sq. mm
d)	Total sectional area	: 399.6 sq. mm
e)	Overall Diameter	: 25.97 mm
f)	Approximate weight	
	i) Aluminium	: 898.2 Kg/Km
	ii) Steel	: 594.2 Kg/Km
	iii) Total	: 1492.4Kg/Km
g)	Calculated DC resistance at 20 deg. C	: 0.08989 Ohms/Km
h)	Breaking load of conductor	: 89.67 kN

### 3.2 TOLERANCES

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of individual strands and lay-ratio of the conductor:

c) Diameter of Aluminium & Steel Strands

	Nominal	Maximum	Minimum
Aluminium	3.71 mm	3.74mm	3.68mm
Steel	3.71 mm	3.76 mm	3.65 mm

d) Lay ratio of conductor

	Max.	Min.
6 wire layer (steel)	30	20
12 wire layer (Al.)	21	14
18 wire layer (Al.)	14	11.25

**SECTION-4****Technical Specification for Polymeric Insulator****1.0 Scope**

This specification covers the design, manufacture, testing & supply of Polymeric Insulators.

**2.0 Codes and Standards**

The Polymeric Insulator shall be designed, manufactured & tested in accordance with the following National / International Standards (IS/IEC).

<b>Sl No</b>	<b>Indian Standard</b>	<b>Title</b>	<b>International Standard</b>
1	IS:209-1992	Specification for zinc	BS:3436
2	IS:406-1991	Method of Chemical Analysis of Slab Zinc	BS:3436
3	IS:731-1991	Porcelain insulators for overhead Power lines with a nominal voltage greater than 1000 V	BS:137- (I&II) IEC:60383
4	IS:2071 Part (I) – 1993 (Part(II)-1991, Part(III)-1991	Methods of High Voltage Testing	IEC:60060-1
5	IS:2486 Part- I-1993 Part- II-1989 Part-III-1991	Specification for Insulator fittings for Overhead Power Lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	BS:3288 IEC:60120 IEC:60372
6	IS:2629-1990	Recommended Practice for Hot, Dip Galvanization for iron and steel	ISO-1461 (E)
7	IS:2633-1992	Testing of Uniformity of Coating of zinc coated articles	
8	IS:3188-1988	Dimensions for Disc Insulators	IEC:60305
9	IS:6745-1990	Determination of Weight of Zinc Coating on Zinc coated iron and steel articles	BS:433-1969 ISO:1460-1973
10	IS:8263-1990	Methods of RI Test of HV insulators	IEC:60437 NEMA Publication No.07/ 1964/ CISPR
11	IS:8269-1990	Methods for Switching Impulse test on HV insulators	IEC:60506
12		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC: 60575
13		Salt Fog Pollution Voltage Withstand Test	IEC:60507
14		Composite insulators for A.C. Overhead lines with nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria	IEC 61109

15		Guide for the selection of insulators in respect of polluted conditions	IEC:60815
16		Tests on insulators of Ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC:60383
17		Characteristics of string insulator units of the long rod type	IEC : 60433

### 3.0 Service Conditions:

The Polymeric Insulator to be supplied against this specification shall be suitable for satisfactory continuous operation under the following service conditions:

- a) Maximum ambient temperature (Degree C) 50
- b) Minimum ambient temperature (Degree C) 0
- c) Relative Humidity (%) 100
- d) Maximum annual rainfall (mm). 1450
- e) Maximum wind pressure (Kg/Sq.m) 150
- f) Maximum Altitude above mean sea level (Meters) 1000
- g) Seismic level (Horizontal Acceleration) 0.30
- h) Climatic Conditions : Moderately Hot and humid tropical climate conducive to rust and fungus growth
- i) Ref Ambient Temperature for Temperature (Degree C) 50

### 4.0 Design Feature:

#### 4.1 Details of Composite Long Rod Insulators:

- The insulators of the strings shall consist of composite long rod insulators for a three phase, 50 Hz, effectively earthed transmission system application in a very heavy polluted environment. Couplings shall be ball and socket type.
- Bidder shall quote such composite insulators which have proven use under foggy/humid operational conditions in polluted environment combined with smoke and dust particles. The Bidder shall furnish evidence in the form of certification from the power utilities that the similar type of product supplied to them had been performing satisfactory. The Bidder shall also submit certified test report (from CPRI/ERDA) for an accelerated ageing test of 5000 hours such as that described in Appendix-C of IEC-61109.
- Insulators shall have sheds of the “open aerodynamic profile without any under ribs” with good self-cleaning properties. Insulator shed profile; spacing projection etc. shall be strictly in accordance with the recommendation of IEC-60815.

- The size of long rod insulator, minimum creepage distance, electromechanical strength and mechanical strength of insulator string along with hardware fittings up to 66 KV shall be as follows-

Sl. No	Type of String	Size of Composite Insulator (mm)	Min. Creepage Distance (mm)	EM strength of Insulator Unit (KN)	Mechanical strength of Insulator string along with Hardware fittings (kN)
1	Single Suspension	20X870	2280	90	90
2	Single Tension	20X870	2280	120	120

**\* Note:** The core dia. of composite insulators mentioned at column No.3 is minimum requirement. The bidder shall offer composite long rod insulators of suitable core dia to meet specified E&M strength requirements. However, the overall string length shall be within the limits specified in the drawing

## 4.2 Pin and Cap:

- Pin and cap shall be designed to transmit the mechanical stress & develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric of such design that it will not yield or distort under load conditions
- The design shall be such as to permit easy removal of replacement of either insulator units or fittings under the live line conditions.

## 4.3 Ball and Socket Designation:

The dimensions of the Ball and Socket shall be of 16 mm for 90kN & 120kN Insulators in accordance with the standard dimensions stated in IEC: 120/ IS: 2486 (Part-II).

## 4.4 Dimensional Tolerance of Composite Insulator:

The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows:

$\pm (0.04d+1.5)$  mm when  $d \leq 300$  mm.

$\pm (0.025d+6)$  mm when  $d > 300$  mm

Where 'd' is in mm being the diameter, length or creepage distance.

**\* Note-no negative tolerance shall be applicable to creepage distance.**

## 4.5 Materials:

- Core-** It shall be a glass-fiber reinforced (FRP rod) epoxy resin rod of high strength. Glass fibers and resin shall be optimized. The rod shall be electrical grade corrosion resistant (ECR), **boron free** glass and shall exhibit both high electrical integrity and high resistance to acid corrosion.
- Housing and Weather sheds-** The FRP rod shall be covered by a seamless sheath of a silicone rubber compound of a thickness of minimum 3mm. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the FRP rod against environmental influences,

external pollution and humidity. It shall be extruded or directly molded on the core. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be furnished along with the bid. The details for this shall be finalized during detailed engineering and finalization of MQP.

- **End Fittings-** End fittings transmit the mechanical load to the core. They shall be made of malleable cast iron spheroidal graphite or forged steel. They shall be connected to the rod by means of a controlled compression technique. The manufacturer shall have in-process Acoustic emission arrangement or some other arrangement to ensure that there is no damage to the core during crimping. This verification shall be in-process and done on each insulator. The gap between fitting and sheath shall be sealed by a flexible silicone rubber compound. The system of attachment of end fitting to the rod shall provide superior sealing performance between housing and metal connection. The sealing must be humidity proof and durable with time
- **Corona Ring/Grading Ring-** Grading rings shall be used at both ends of each composite insulator unit for reducing the voltage gradient on and within the insulator and to reduce radio and TV noise to acceptable levels. The size and placement of the metallic grading rings shall be designed to eliminate dry band arcing/corona cutting/ exceeding of permissible electrical stress of material. The bidder shall furnish calculations along with the proposed placement and design of corona ring in support of the above. Grading rings shall be capable of installation and removal with hot line tools without disassembling any other part of the insulator assembly.

\* **Note:-**The supply of grading rings shall be in the scope of the composite insulator supplier.

## **5.0 General Requirement:**

**5.1 Interchangeability-** The composite long rod insulators inclusive of the ball & socket connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC standards.

**5.2** All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and shall not generate any radio interference beyond specified limit under the operating conditions.

**5.3** The long rod insulators offered shall be suitable for employment of hot line maintenance technique so that usual hot line operation can be carried out with ease, speed and safety.

**5.4** All insulators shall be designed to facilitate cleaning and insulators shall have the minimum practical number of sheds and grooves. All grooves shall be so proportioned that any dust deposit can be removed without difficulty either by wiping with a cloth or by remote washing under live line condition.

**5.5** All the materials shall be of latest design and conform to the best modern practices adopted in the extra high voltage field. Bidders shall offer only such insulators as are guaranteed by him to be satisfactory and suitable for transmission lines specified and will give continued good service



- 5.6** The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners to limit corona and radio interference
- 5.7** The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
- 5.8** The core shall be free from cracks and voids which may adversely affect insulator.
- 5.9** Weather sheds shall be uniform in quality. They shall be clean, sound, smooth and free from gross defects and excessive flashing at parting lines.
- 5.10** End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona.
- 5.11** All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
- 5.12** All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 600 gm/sqmm and shall be in accordance with the requirement of ISO:1461 (E) and shall satisfy the tests mentioned in ISO:1460 (E). The zinc used for galvanizing shall be of purity of 99.95%. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least six successive dips each lasting for one (1) minute duration under the standard test. The galvanizing shall be carried out only after any machining

## 6.0 Quality Assurance:

Vendor Quality Plan	To be submitted for purchaser approval
Inspection Points	To be mutually identified & agreed in quality plan

## 7.0 Testing and Inspection:

### 7.1 Type Test:

The insulators should be offered type tested from CPRI/ERDA. Type test reports should not be more than 5 (Five) years old considered from the date of bid opening in respect of all the tests carried out in CPRI/ERDA, based on ISO/IEC.

IEC:383-1993	On the complete composite Long Rod Insulator String with Hardware Fittings	Power frequency voltage withstand test with corona control rings/grading ring and arcing horns under wet condition
		Switching surge voltage withstand test under wet condition
		Impulse voltage withstand test under dry condition

		Corona and RIV test under dry condition
		Mechanical Strength test
		Vibration test
		Salt-fog pollution withstand test
IEC: 61109	On Composite Insulator Units (Tests on interfaces and connections of metal fittings)	Dry power frequency voltage test
		Sudden load release test
		Thermal mechanical test
		Water immersion test
		Steep front impulse voltage test
		Dry power frequency voltage test
IEC: 61109	On Composite Insulator Units (Assembled core load time test)	Determination of the average failing load of the core of the assembled unit
		Control of the slope of the strength time curve of the insulator
	Brittle fracture resistance test	
	Test of housing, Tracking and erosion test	
	Tests for the core material	Dye penetration test
		Water diffusion test
	Flammability test	
	Recovery of Hydrophobicity test	
	Mechanical Load Time test and test of tightness between end firings and insulator housing	
	Silicone content test	
	High Pressure washing test	

## 7.1 Acceptance Test : The following tests shall constitute the Acceptance : -

IS/IEC Reference	Test Description
IEC : 61109	Verification of dimensions
	Verification of tightness of interface between end fittings and insulator housing and of specified mechanical load
	Tests on interfaces and connections of metal fittings (Tests to be performed on the same samples in the sequence given below)- i) Dry power frequency voltage test, ii) Sudden load release test, iii) Thermal mechanical test, iv) Water immersion test, v) Steep front impulse voltage test, vi) Dry power frequency voltage test
IEC : 60383	Galvanizing test (IS:209-1979)

	Verification of locking system
	Recovery of Hydrophobicity
	Silicone content test

**Note:** - 1) Test on interfaces and connection shall be carried out for a lot with qty. minimum 2000 nos.  
2) Test for silicon shall be carried out for a lot with qty. minimum 2000 nos.  
3) In the event of failure of the sample to satisfy the acceptance test(s) specified above, the retest procedure shall be as per clause 7.6 of IEC 61109

**7.2 Routine Tests:** The following tests shall constitute the

- 1) Visual Inspection as per IEC 61109
- 2) Mechanical Routine Test as per IEC 61109

**7.3 Test During Manufacturing:**

- 1) Chemical analysis of Zinc used for galvanizing.
- 2) Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
- 3) Chemical analysis hardness tests and magnetic particle inspection for forging.
- 4) Tracking and erosion test on insulating material

**Inspection:**

SL No.	Descriptions
7.3.1	The buyer reserves the right to witness all tests specified on Polymeric Insulators
7.3.2	The buyer reserves the right to inspect Polymeric Insulators at the Seller's works at any time prior dispatch, to verify compliance with the specifications
7.3.3	In-process and final inspection call intimation shall be given in advance to purchaser
7.3.4	In the event of any discrepancy in the test report i.e. test reports not acceptable or any type test (including special/additional test if any) not carried out, same shall be carried out without any cost implication to BSES before dispatch.

**Note:**

- 1) The routine and acceptance tests should be performed on sample chosen at random out of every lot.
- 2) Three sets of complete test certificates shall be submitted along with the dispatch documents.

**8 Shipping, Handling and Site Support:**

8.1	Packing	All insulators shall be packed in suitable PVC/ plastic tubes/any other suitable packing along with temporary wrap-on shields/shrouds for each insulator unit. The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field
		Suitable cushioning, protective padding, or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling
		The items so wound will be grouped as per numbers per packet. The information like product quantity shall be mentioned on the packets
		Purchase order no. with SAP code shall be mentioned clearly
		Net weight and gross weight with packet shall be mentioned
		Batch no. or lot no shall be mentioned
8.2	Shipping	The seller shall give complete shipping information concerning the gross weight, size of each packing and the seller has to send the materials to buyer's preferable store or site.
8.3	Handling & Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.
8.4	Transit damage	The seller shall be responsible for any transit damage due to improper packing.

## **9 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 by the Buyer that the Seller complies fully with this specification.

## **10 Drawings and Materials Details:**

The bidder has to submit drawings along with bid for preliminary acceptance and for final approval before manufacturing. BRPL may insist trial installation to check dimensions and may suggest necessary changes if required. BRPL decision in this regard would be final and binding to short listed vendor without any subsequent commercial liability on purchaser.

### **Marking:**

The Following information shall be marked on each cross arm:

**10.1** Manufacturer's name or trade mark

**10.2** Year of manufacture

**10.3** BSES-BRPL, order number, date & SAP Code number

**SECTION- 5**  
**TECHNICAL SPECIFICATIONS FOR HIGH TENSILE GALVANISED STEEL EARTH WIRE**

**1.0 STANDARDS:**

The High Tensile Galvanized Steel Earth Wire shall conform to the following Indian Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified hereinbefore.

<b>S. No.</b>	<b>Indian Standards or any Equivalent International Standard</b>	<b>Title</b>
1	IS:209 -1992	Specification for Zinc
2	IS:2141 -1992	Specification for Earth wire for overhead Transmission purpose
3	IS:1778	Reels and drums for Bare wires
4	IS:1521	Method of Tensile Testing of Steel wire
5	IS:2629 -1992	Recommended practice for Hot Dip Galvanising Iron and Steel
6	IS:2633 -1992	Method of Testing Uniformity of Zinc coating of Zinc coated Articles.
7	IS:4826	Galvanised coating on Round Steel wire
8	IS:6745 -1992	Method of Determination of weight of Zinc coating of zinc coated Iron and Steel Articles
9	IS: 12776	Method of Testing of Earth wire

**2.0 PARAMETERS:****2.1 PRINCIPAL PARAMETERS OF EARTH WIRE:**

The standard technical particulars of 7/3.15mm galvanized steel earth wire shall be as follows:-

## a. The details of Steel strand:

i.	Material	Steel
ii.	Stranding	7
iii.	Weight per Km	428 Kgs
iv.	Dia. of wire	3.15 mm
v.	Tolerance	2%
vi.	Minimum elongation in 100 mm	5 mm length
vii.	Minimum breaking strength per strand	1000 Kg
viii.	Minimum tensile strength	95 Kg./mm <sup>2</sup>
ix.	D.C. resistance at 20 Deg. C	3.14 Ohms/Km

## b. The details of Stranded Earth Wire :

i.	Maximum Length of Lay	265
ii.	Minimum Length of Lay	127
iii.	Minimum breaking load	<b>5600 Kgs</b>
iv.	Overall diameter	10.98mm
v.	Modulus of elasticity	1.933 x 10 <sup>6</sup> Kg./cm <sup>2</sup>
vi.	Co-efficient of linear expansion	11.50 x 10 <sup>-6</sup> per Deg.C
vii.	Weight of zinc coating on wire	260 gms./ m <sup>2</sup> (Min.)
viii.	No. of one minute dip and half minute dip respectively	3 one minute and 1 half minute
ix.	Calculated d.c. Resistance at 20 Deg.C	3.14 Ohms per Km

## 3.0 GENERAL TECHNICAL REQUIREMENT : MATERIAL AND WORKMANSHIP FOR EARTH WIRE:

- 3.1** The steel wire (strands) used in manufacture of galvanized steel earth wire shall be drawn from steel wire rod produced by either acid or basic open hearth process or by the electric furnace process or basic oxygen process. The steel wire shall not have sulphur and phosphorous contents exceeding 0.045% each. The carbon content shall not exceed 0.55%. The steel produced by bassemmer process shall not be used for drawing of steel wire strands. The finished earth wire shall have minimum brittleness as it will be subjected to continuous vibration while in use on line.
- 3.2** The steel wire shall be hot dip galvanized and shall have zinc coating of minimum 260 gram per sq. meter of the uncoated wire surface. The zinc coating shall be smooth and continuous of uniform thickness, free from imperfections not consistent with good commercial practice and shall meet the test requirement. The zinc used in galvanizing of earth wire shall be as per IS: 209-1992.
- 3.3** All the steel wires shall be circular, smooth, uniform and free from imperfections, such as spills and splits, die marks scratches, abrasions, cuts and kinks etc. drawing and after stranding.

**3.4** The steel wires, after galvanizing shall be bright in appearance, smooth and free from all defects like flux, ash, cross inclusions, bare and black spots, pimples, lumpiness in runs, rust, stains, bulky white deposits and blisters.

**3.5** The finished earth wire shall have a smooth surface without any surface cuts, abrasions, scuff marks and shall be free from dirt, grit etc.

#### **4.0 SIZE AND PROPERTIES:**

**4.1** The earth wire size, physical properties, tolerance in diameter of individual strands and length of lay of the strand shall be as given above.

**4.2** The wires shall be so stranded together that when an evenly distributed pulls is applied at the end of completed strands, each wire will take an equal share of the pull.

**4.3** The earth wire shall be supplied in the standard lengths which shall not be less than 3 Km. Not less than 95% of the total quantity of the earth wire shall be supplied in standard lengths. The quantity of earth wire in length shorter than standard one shall not exceeds 5% of the total quantity to be supplied. Further, no single earth wire length in respect of such 5% (maximum) supply in random lengths shall be shorter than 50% of the standard length.

**4.4** The length of the stranded wire shall be supplied without joints in the individual wires comprising it, excluding welds made in base rod before it is drawn.

**4.5** Each coil be warranted to contain no welds, joints or splice other than in the base rod before it is drawn.

#### **5.0 GALVANISING AND OILING:**

**5.1** All the wires of the strand shall be galvanized in accordance with IS-2629-1990. Recommended practice for Hot dip galvanizing of Iron and Steel of some other authoritative equivalent standard.

**5.2** The galvanized earth wire after stranding operation shall have dipped in boiled linseed oil before winding it on drums.

#### **6.0 TEST FOR EARTH WIRE :**

**6.1** Earth wire shall be subjected, before dispatch from the works to tests as specified in the IS-2141, IS 1521, IS 1755 & IS 4826 or any other authoritative equivalent standard.

**6.2** All the drums of galvanized steel stranded earth wire of the same grade, diameter and construction, manufactured under similar condition shall be grouped to constitute one lot.

**6.3** Samples from each lot shall be tested for ascertaining the conformity to the requirements of the earth wire specified herein. The drums selected shall be tested for length of the lay and diameter of individual strands etc. The lot shall be declared conforming to the requirement of these characteristics if all the samples are found satisfactory. One test specimen from each wire of the strand shall now be drawn from every selected drum and subjected to chemical analysis, tensile tests, ductility test, elongation test and coating test. One test specimen, of the completed strand from each drum shall be subjected to tensile strength. The lot shall be declared conforming to the requirements of these characteristics, if the entire test specimen satisfies the relevant requirement.

#### **7.0 END SEALING :**

Both the ends of each length of earth wire should be provided with non-destructive type metal crimped or epoxy capped seals with punching embossing/ engraving of manufacturer's monogram and drum number.

**SECTION- 6****TECHNICAL SPECIFICATION FOR HARDWARE FITTINGS FOR 66KV LINES****1.0 STANDARDS:**

This section provides for the Design, manufacturing, stage testing, inspection and testing before dispatch, packing and delivery of Hardware fittings Conductor and Earth wire for use on 66KV transmission lines. The material and services under this specification shall be performed as per the requirements of the latest revisions and amendments available at the time of placement of order of all the relevant Indian Standards/Codes listed here under or equivalent International Standards, except as modified in this document:

<b>S. No</b>	<b>Indian Standard</b>	<b>Title</b>
1	IS:209-1992	Specification for Zinc Ingot
2	IS:206 – 1992	Tee and Strap Hinges
3	IS:7814-1985	Phosphor Bronze Sheet and Strip
4	IS:2071	Method of high voltage testing
6	IS:961	Structural Steel
7	IS:1385	Phosphor Bronze Rods & Bar Sheet and Strips and Wire
8	IS:2004	Carbon Steel Forgings for General Engineering Purpose
9	IS:2107	White Hearth Malleable Iron Castings
10	IS:2108	Black Hearth Malleable Iron Castings
11	IS:2121(Part -I & II)	Specification for Conductors and Earth wire Accessories for Overhead Power Line, Armour Rods Binding Wires and Tapes for Conductor
12	IS:2486	Specification for Insulator Fittings for Overhead Power Lines with a Nominal Voltage Greater than 1000 V.
13	IS:2629	Recommended Practice for Hot Dip Galvanization of Iron and Steel.
14	IS:2633	Testing of Uniformity of Coating of Zinc coated



		Articles
15	IS:3138	Hexagon Bolts and Nuts
16	IS:6639	Hexagon Bolts for Steel Structures
17	IS:6745	Determination of Weight of Zinc Coating on Zinc Coated Iron and Steel Articles
18	IS:3188	Characteristic of String Insulators Units
19	IS:4218	ISO Metric screw Threads
20	IS:4172	Dimensions for Radii under the Heads of Bolts & Screws
21	IS:4206	Dimensions for nominal lengths and Thread length for Screws and Studs (with amendment)
22	IS:4759	Hot Dip Zinc Coatings on Structural Steel and other Allied Products
23	IS:1573	Electroplated Coatings of Zinc on Iron and Steel
24	IS: 398	Specification for Aluminium Conductor Steel Reinforced for overhead transmission purpose.
25	IS: 1327-1966	Methods for determination of weight of tin Coating on Tin Plates
26	IS: 4826-1979	Hot Dip Galvanised Coating on Round Steel Wires
27	IS: 1363	Hexagon Head Bolts, Screws & Nuts.
28	IS: 1367	Technical supply conditions for threaded Steel Fasteners
29	IS: 9708	Stockbridge Vibration Dampers for Overhead Power lines.
30	IS: 8263	Method of Radio Interference Tests on High Voltage Insulators.
31	IS:10162	Spacers and Spacer Dampers for twin horizontal bundle Conductors.
32	IS: 2004	Carbon Steel Forgings for general engineering purposes.
33	BS:970 (Part-I)	General Instructions and Testing Procedures Specific Requirements for Carbon and Carbon Manganese Alloy and Stainless Steels.

## **2.0 INSULATOR STRING CHARACTERISTICS:**

The Hardware fittings shall be suitable for single/double suspension Insulator strings and single/double tension Insulator strings. Each Hardware fitting shall be supplied complete in all respect and shall include all components, which are required for making complete set.

2.1.1 The complete insulator string including Hardware fittings shall have the following characteristics:

<b>Sr. No.</b>	<b>Details</b>	<b>Single/Double suspension 66kV</b>	<b>Single/Double tension 66kV</b>
1	Lighting impulse voltage (dry) KV peak	375	375
2.	Power frequency withstand voltage (wet) KV rms	275	275
3	Mechanical failing load kgf.	7000	9000/18000
4	No deformation load-kgf.	4690	6030/12060

The Insulator string Hardware fittings and Earth wire assemblies shall comply and conform to the above requirement.

### **2.2.0 REQUIRED GUARANTEED STRENGTH OF HARDWARE OF INSULATOR STRINGS:**

2.3.0 The Hardware and Clamps of 66kV single suspension and double suspension strings suitable for Goat ACSR for transmission line and shall have the ultimate breaking strength of not less than 13600 kgs. The Compression Clamp shall have slipping strength not less than 95% of breaking strength of Goat ACSR.

2.3.1 The slipping strength of the suspension clamp shall not be less than 15% and more than 20% of the Conductor strength with which it is to be used.

2.3.2 Each individual Hardware component of double suspension and double tension strings such as ball-clevis, socket clevis etc. shall have minimum breaking strength as specified for respective single suspension and tension string respectively.

## **3.0 PARTICULARS OF HARDWARE FITTINGS:**

Each Hardware fitting for the transmission line shall be complete in all respect and Bidder should furnish complete drawings and technical particulars of the items of hardware fittings. The Hardware fittings should normally comprise items conforming to enclose drawing as under: -

### **3.1 Single Suspension Hardware Fitting With AGS Type Clamp:**

Single suspension Hardware string shall comprise of one Ball Hook, one Socket Eye Horn holder, one line side Arcing Horn and one Suspension Clamp of AGS type with armour rod suitable for respective sizes of Conductors.

### **3.2 Double Suspension String Hardware Fittings with AGS Type Clamp:**

The double suspension string Hardware fittings shall comprise of one Ball Hook, one Socket Clevis, one Top Yoke Plate, two Ball Clevis, two Socket Clevis, one bottom Yoke Plate, two line side Arcing Horns, one Clevis Eye and one AGS type Suspension Clamp suitable for respective sizes of Conductors.

**3.3 Single Tension String Hardware Fittings:**

Single tension string Hardware shall comprise of one 'D' Shackle, one Ball Link, one Forged Steel Socket, Socket Clevis Horn holder, one line side Arcing Horn and one Tension Clamp of compression type

**3.4 Double Tension String Hardware Fittings:**

The double tension string Hardware shall comprise of two 'D' shackle, one chain link one top yoke plate, two ball clevis, two socket clevis, one bottom yoke plate, one line side arcing horn, one clevis and a compression type dead-end Clamp

**3.5 Earth Wire Suspension Assembly With Preformed Armour Rods:**

This shall comprise of envelope type Suspension Clamp of heat-treated malleable iron, one Chain Link and one 'D' Shackle. The entire assembly shall be hot dip galvanized complete with minor accessories. The breaking strength of all the Hardware items of the assembly shall not be less than 7000 kgs. The complete assembly of suspension clamp shall be guaranteed for slip strength of not less than 15 KN & not more than 19 KN.

**3.6 Earth Wire Tension Assembly:**

The Earth wire tension assembly shall have minimum breaking strength equal to that of the Earth Wire. The slipping strength of the Compression Clamp shall not be less than 95% of the breaking strength of Earth Wire. The strain assembly of the Earth wire for transmission line shall comprise of compression type dead end Clamp and two 'D' Shackles complete with minor accessories such as pins, bolts & nuts etc. Strain assembly shall be hot dip galvanized and made inherently resistant to the atmosphere corrosion. The dead end Clamp of the assembly shall be of compression type. The tension clamp shall be attached to the horizontal strain plate of the tower body by means of a "D" shackle. "D" shackle shall be suitable for attaching the tension clamp to strain plate of towers having 8mm thickness with a hole of 21.5 mm diameter. The tension clamp body shall be made out of steel of 304 L grade or equivalent with Brinell Hardness not exceeding 200. The complete assembly shall also include one 12.5mm dia, 45 mm long HRH MS Bolt hot dip galvanized with nuts and lock washers for attaching G.I. earth bond.

**3.7 Mid Span Joints and Repair Sleeves:**

- I. The Mid Span Joints for Conductor & Earth wire shall be compression type.
- II. The Conductor Mid Span Joints shall comprise of Aluminum and Steel Sleeves. The Earth wire Mid Span Joints and Steel Sleeves of Conductor Mid Span Joints shall be Hot dip Galvanized. Sleeves shall be of circular shape suitable for compression into hexagonal shape. The detailed drawing showing the length of Sleeves, inner and outer cross sectional dimension, before compression for Aluminum corresponding dimensions of hexagon after compression for Aluminum and Steel Sleeve shall be indicated. The Aluminum Sleeve shall be of extruded Aluminum. The material of the Steel Sleeve shall be specified.
- III. The Repair Sleeve of Conductor shall be in two halves preferably of same shape, and this should be of extruded Aluminum. The Repair Sleeve for Earth wire shall be single piece and Hot dip Galvanized. Its material shall be specified. The Repair Sleeves shall be of circular shape suitable for compression into hexagonal shape.
- IV. The steel and Aluminum Sleeves for Mid Span Joints as well as Aluminum Repair Sleeves and Steel Repair Sleeves shall have their outer dia tapered towards the two ends. Also the inside of the Sleeves shall be well rounded off, so that there is no sharp edge, which can cut the strands.
- V. The Joints and Repair Sleeves shall conform to IS:2121/1981 or equivalent International Standard.
- VI. The conductor compressed with mid span joint or with repair sleeve shall not permit slipping of, damage to or failure of complete conductor or any part thereof at a load of not less than 95% of the ultimate tensile strength of the conductor.

- VII. The electrical resistance of the joint/repaired portion of the conductor shall not exceed 75% of the measured resistance of equivalent length of conductor.

### **3.8 4R-VIBRATION DAMPERS FOR GOAT ACSR:**

Only Vibration Dampers having 4-resonance frequency characteristic commonly called 4R Dampers shall be offered. The Damper shall eliminate fatigue on the Conductor due to vibration and damp-out the vibrations effectively, so that no damage due to vibration is caused to Conductor and string.

The Dampers are to be used at all tension locations and suspension locations. One or more Dampers are proposed to be used on tension/suspension locations depending upon the span. The Damper shall be such as to effectively damp out the vibration on the conductor, so that the dynamic strain at the suspension point with conventional type of Suspension Clamp 'U' bolt and keeper pieces, shall not exceed 150 micro strains. Contractor shall recommend the number of Dampers required to effectively damp out the vibration of the Conductor, so that the dynamic strain at the suspension point with conventional Suspension type Clamp shall not exceed 150 micro strains.

The requirement indicated in Schedule-I Ais based on use of two Vibration Dampers per Conductor per span. However, final requirement will depend upon Bidder's recommendations duly supported by literature. Contractor shall also recommend the number of Dampers required to effectively damp out Conductor vibration for different values of span lengths and the distance for fixation. While working out Damper Characteristics, it may be kept in view that on suspension locations, preformed Armour rods are also to be fitted on the conductor. Contractor shall give full details of the damper characteristics and energy dissipation curves of the Damper and shall also guarantee their effectiveness for damping design.

The messenger cable shall be made of high strength steel strands of spring steel with a minimum strength of 136 Kg/sq. mm and preformed in order to prevent subsequent dropping of weights in service. The Contractor shall indicate full technical particulars of the messenger cable. The keeper pieces shall have proper curvature and edges be rounded off so that it shall have proper grip over the conductor without any damage to conductor strands. Clamping bolts shall be provided with self-locking nuts designed to prevent corroding of the threads or loosening during service ensuring that no slippage occurs up to specified longitudinal force on clamp along the conductor. All ferrous parts including the messenger cable shall be effectively sealed to prevent corrosion.

The collar for fixing the bolt shall be designed in such a way that sufficient space is available for tightening the bolt through spanner. Further bolt length be maintained in such a way that it should not come out completely while affixing the clamp on Conductor.

Fixing of the masses to the messenger cable shall be done by pressing Aluminium Sleeves at each end of the messenger cable under pressure. Each end should be sealed properly so as to achieve perfect joint. The molten metal filling method for attachment of messenger cable to counter weight is not acceptable.

### **4.0 COMPONENTS OF HARDWARE FITTINGS:**

All components for hardware fittings shall be as per IS 5561 and any other relevant IS to meet the requirement.

### **5.0 DIMENSIONS & TOLERANCES:**

- 5.1 The dimensions and tolerances of pin balls and socket ends shall conform to IS 2486 Part-II/IEC-120 and shall be checked by the gauge therein after galvanizing.
- 5.2 The bearing surfaces of balls and machined sockets, before galvanizing shall not have surface roughness more than 250 micro inches.
- 5.3 The bearing surface of socket ends shall be uniform about the entire circumference without

depressions or high spots. The internal contour of the socket ends shall be concentric with the axis of fittings. The axis of the bearing surface of socket ends shall be coaxial with the axis of fittings with no appreciable tilting.

## **6.0 IMPORTANT CONDITIONS:**

- 6.1 All Hardware items shall be complete with minor items such as security clip, bolts, nuts, washer, split pins and inners etc.
- 6.2 All ferrous fittings (except those specified otherwise) shall be hot dip galvanized, after all machining and fitting has been completed, in accordance with relevant Indian Standard. All Hardware items (other than clamps) and those specified otherwise should be made of Drop Forged Steel. Socket items in forged steel must be forged. All forgings supplied should be stress relieved and this treatment should be done at the Contractor works. Forgings, which are not stress relieved, will not be acceptable. The items like Yoke Plate, Arcing Horn, Bolts and Nuts shall be of mild steel and rest of the items shall be of forged steel.
- 6.3 All Bolts, Nuts and Screw heads shall have only wide worth standard thread and of sizes indicated in the enclosed drawing. Bolts head and Nuts shall be hexagonal. Where required, nuts shall be locked in approved manner. The thread in Nuts shall be over tapped after galvanizing and shall be cut before galvanizing. The threads shall not be undercut. The Nuts should be tapped such that they are fit on the bolt threads i.e. these should not have loose fitting.

## **7.0 GALVANISING:**

- 7.1 Hot dip galvanizing shall conform to Indian Standard specification IS-2633 or equivalent International Standard. Galvanising shall be uniform, free from blisters, and shall not peel off due to abrasion, Zinc coating shall be thick enough to withstand 6 one minute dips in Copper Sulphate solution (precee test) for all ferrous parts except for threaded portions which shall withstand at least 4 one minute dips.
- 7.2 The Contractor must emboss/engrave their name in each forged steel item and Aluminium castings such as Ball Hook, Yoke Plate, Socket Clevis, Clevis Eye, Clevis-Clevis, Anchor Shackle/D-Shackle, Chain Link, Suspension Clamps of AGS type, Tension Clamps and Arcing Horns.

## **8.0 TESTS :**

- 8.1 The hardware fittings offered shall be type tested as per the relevant standards. Further the acceptance, routine tests and tests during manufacture shall be carried out on the conductor.
- 8.2 Acceptance tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purpose of acceptance of that lot.
- 8.3 Routine tests shall mean those tests which are to be carried out on each and every product so as to check with requirements which are likely to vary during production.

## **9.0 ACCEPTANCE TEST/SAMPLE TESTS:**

### **9.1 Suspension and tension hardware fittings:**

- |    |  |                            |
|----|--|----------------------------|
| a. | Visual Examination                       | IS:2486 (Part-I)           |
| b. | Verification of dimensions               | IS:2486 (Part-I)           |
| c. | Galvanizing test/Electroplating          | As per this Specification. |
| d. | Mechanical strength test of welded joint | As per this Specification. |
| e. | Mechanical strength test for             | BS:3288(Part-I)            |

corona control rings.

- |    |  |                            |
|----|--|----------------------------|
| f. | Test on locking devices for ball & socket coupling.  | IEC:372(2)                 |
| g. | Mechanical strength test of each components excluding corona control ring and arcing horn. | As per this specification. |

## 9.2 Suspension Hardware fittings only:

- a. Clamp slip strength vs torque test for suspension clamp.
- b. Shore hardness test of elastomer cushion for AG suspension clamp.
- c. Bend test for armour rod set.
- d. Re silence test for armour rods set.
- e. Conductivity test for armour rods

## 9.3 Suspension hardware for Earth wire.

- a. Visual examination
- b. Dimensional verification.
- c. Slip strength test.
- d. Mechanical strength test on each component
- e. Galvanising test
- f. Mechanical strength test of welded joint

## 9.4 Tension hardware for Earth wire

- a. Visual examination
- b. Dimensional verification.
- c. Slip strength test.
- c. Electrical resistance test .

## 9.5 Midspan Compression Joint for Power Conductor & Earth wire

- a. Visual examination
- b. Dimensional verification.
- c. Galvanising Test
- d. Hardness test.
- e. Failing load test (test to be conducted after 24 hours of compression).

## 9.6 Repair Sleeves for Conductor.

- a. Visual examination
- b. Dimensional verification.

## 9.7 Vibration Damper for power conductor/ Earth wire.

- a. Visual examination
- b. Dimensional verification.
- c. Galvanizing Test
- d. Verification of resonance frequencies
- e. Clamp slip test
- f. Clamp bolt torque test
- g. Strength of messenger cable.
- h. Mass pull off test.

## 9.8 Clamps

- i. Tensile Test
- ii. Resistance Test
- iii. Dimensional Check
- iv. Galvanizing Test

### ANNEXURE-1

#### GURANTEED TECHNICAL PARTICULARS of ACSR Conductor (SEPARATE DATA SHEET SHALL BE SUBMITTED FOR EACH TYPE OF CONDUCTOR)

SI.NO.	DESCRIPTION	BRPL Requirement	PARTICULARS
1.	Name of the material offered	XLPE Insulated Conductor ACS R	
2.	Maker's Name	Required	
3	Address and Phone No.		
4	Reference Standards	IS-398 Pt-3, IS-7098 Pt-1, IS 17778-80	
5	No. of strands/diameter of Galvanized steel wire/Al strand	Required	
6	Apporx. Dia over covered conductor		
7	Minimum Ultimate Tensile Strength of Conductor	18.25	
8	Direction Of Lay	Successive layers shall have opposite directions of lay outermost layer being Right Handed	
9	Lay ratio of Aluminum wire	10-14	
10	Continuous max.current rating of ACSR Conductor in still air at an ambient temperature at 45 Deg C	Required	
11	Temperature rise for the above current	Required	
12	Short Circuit current rating of ACSR Conductor for 1sec	Required	
13	Module of elasticity of complete conductor	79	
14	Coefficient of linear expansion of complete conductor	$19.1 \times 10^{-6}$	
15	Cross sectional area	Required	
16	Nominal aluminum area	Required	
16.1	Conductivity and Grade of Al	61% EC Grade	



16.2	% Composition of steel wire	As Per spec	
17	Chemical composition certificate from NABL approved lab	Required	
18	Minimum breaking load		
18.1	Aluminum strand ( After Stranding )	Required	
18.2	Galvanized steel wire ( After Stranding )	Required	
19	Total Conductor	Required	
20	Max.Working tension of conductor	75% of UTS	
21	Resistance of Al conductor at 20Deg C(Max)	Required	
22	Weight		
22.1	Aluminum strand	Required	
22.2	Steel Strand	Required	
22.3	Conductor without insulation	Required	
22.4	Conductor with insulation	Required	
23	Purity of AL.rod in %age	Required	
24	Zinc coating on steel wire		
24.1	Grade of Zinc	Electrolytic High Grade Zinc not less than 99.95% purity as per IS209-1992	
24.2	Min wt of Zinc Coating	Required	
24.3	No.& duration of dips of Zinc coating ( Before Stranding)	Required	
25	Type of Insulation	XLPE Type as per IS 7098	
25.1	Nominal thickness of XLPE insulation	1.6	
25.2	Min thickness of XLPE insulation	1.5	
25.3	Color of XLPE insulation	Black	
25.4	Tensile strength of Insulation ( Min )	12.5	
25.5	Percentage elongation at break of Insulation ( Min)	200	
25.6	Insulation resistance test (Volume resistivity) Min	1x10 <sup>14</sup> at 27deg C 1x10 <sup>12</sup> at 90deg C	
26	Chemical composition test certificate of XLPE insulation material	Required, shall be weather proof and have property of protection against ultraviolet light having 2.5% black carbon content	
27	Drum	Required	
27.1	Ref IS	IS-1778-1980	
27.2	Gross weight of drum including weight of conductor	Required	



27.3	Standard length of each piece of conductor	3Km	
27.4	Non standard length	1% of the ordered Quantity & no length less than 50% of the standard length	
28	Order quantity tolerance	(+/-)2%	Yes/No
29	Embossing	Name of manufacturer, Manufacture year, Manufacturing month, Type of conductor, BRPL, P.O. No & date	

## ANNEXURE-2

### GARANTEED TECHNICAL PARTICULARS of POLYMERIC INSULATORS

Sl. No.	Descriptions	Unit	Data to be filled by Manufacturer
1	Name & address of manufacture		
2	Weight of single unit	Kg	
3	Size and designation of ball & socket assembly	mm	
4	Core diameter	mm	
5	Tolerance on core diameter	±mm	
6	Nominal length (section length)	mm	
7	Tolerance on Nominal length	±mm	
8	Dry arcing distance	mm	
9	Number of sheds	nos	
10	Sheds profile (type)		
11	Shed spacing	mm	
12	Sheds profile (regular alternating)		
13	Shed diameter	mm	
14	Tolerance on shed diameter	±mm	
15	Minimum creepage distance	mm	
16	Tolerance on creepage distance	±mm	
17	Guaranteed mechanical strength	KN	
18	Routine mechanical load	KN	
19	Materials		
a	FRP Rod		
b	Weather sheds with % contents of silicon		
c	Housing		
d	End Fitting		
e	Grading Ring		
20	Minimum thickness of sheath covering over the core	mm	
21	Power frequency withstand voltage of single unit		
a	Dry	KV (rms)	
b	Wet	KV (rms)	
22	Power frequency flashover voltage of single unit		
a	Dry	KV (rms)	
b	Wet	KV (rms)	
23	Impulse withstand voltage of single unit (dry)		
a	Positive	KV (peak)	
b	Negative	KV (peak)	
24	Impulse flashover voltage of single unit (dry)		

a	Positive	KV (peak)	
b	Negative	KV (peak)	
25	Purity of zinc used for galvanizing end fittings	%	
26	Number of dips which the end fittings can withstand in standard preece test	Nos.	
27	Certified test report of accelerated ageing test of 5000 hours (enclosed) (appendix-C of IEC-61109)	Yes/No	
28	Drawings Enclosed	Yes/No	

**ANNEXURE- 3**  
**GUARANTEED TECHNICAL PARAMETERS OF HTGS EARTH WIRE**

S.N.	Particulars	Data to be filled by Vendor
1	Particulars of single steel wire before stranding	
a)	No. of wires	7
b)	Diameter (mm)	3.15 mm
b)	Tolerance	
	Plus	
	Minus	
c)	Minimum elongation in 100 mm length	
d)	Breaking load (Kg.)	
	Standard/Minimum	
e)	Minimum ultimate tensile stress (Kg/mm <sup>2</sup> )	
g)	D.C. resistance at 20 deg. C (Ohm/Km)	
2	Stranded Wire	
a)	Length of lay (mm)	
	Maximum	
	Minimum	
b)	Overall diameter of Earth wire(mm)	
c)	Area of cross section of Earth wire(sq. mm.)	
d)	Breaking load (Kg.)	
	Standard/Minimum	
e)	Resistance in Ohms per Km. at 20 deg. C.	
F)	Modulus of elasticity of Earth Wire (Kg/cm <sup>2</sup> )	
h)	Weight of Earth wire (Kg/Km)	
i)	Co-efficient of linear expansion (per deg. C)	
3	Quality of zinc used (Specify the grading and percentage)	
4	Coating of zinc on wires In Gms. Per sq. mtrs.	
5	Nos. of Dip	

6	Oiling/greasing on Earth wire	
7	Tolerance in standard length	

**ANNEXURE-4****GUARANTEED TECHNICAL PARTICULARS OF HARDWARE  
FITTINGS FOR ACSR GOAT AND EARTH WIRE FOR LINE**

GTP of Hardware fittings to be provided by vendors

**ANNEXURE-5****LIST OF DRAWINGS TO BE SUBMITTED for APPROVAL**

<b>S. No</b>	<b>Document / drawing description</b>
1	Route map of proposed 66kV line and associated work of 66kV line
2	Detailed design calculation of Monopole and Foundation
3	IIT Validation of Detailed design calculation of Monopole and Foundation
4	Details of earthing arrangement
5	Number plate
6	Phase plate
7	Danger Board
8	Anti climbing device
9	Flexible Bond for earth wire.
10	Cross sectional drwg for Goat conductor
11	Cross sectional drwg for earth wire
12	66kV Single & Double suspension insulator string hardware for Goat ACSR conductor
13	66kV Single & Double tension insulator string hardware for Goat ACSR conductor
14	Hardware fittings for Earth wire
15	Mid span compression joint for Goat ACSR Conductor
16	Vibration damper for Goat ACSR Conductor
17	Repair sleeve for Goat ACSR
18	Mid span compression joint for earth wire(if any)
19	Vibration damper for earth wire(if any)
20	Repair sleeve for earth wire(if any)
21	Polymeric Insulators
22	Design calculations & drawing of earthing for monopole and earthwire


# **TECHNICAL SPECIFICATION OF IT DEVICES FOR GRID COMMUNICATION**

**DOCUMENT NO.: BRPL-IT-SCADA-0001**

**Rev.: 00**



**BSES RAJDHANI POWER LIMITED**  
BSES Bhawan, Nehru Place,  
New Delhi - 1100049

 <b>BSES</b> BSES Rajdhani Power Limited	Technical Specification of IT devices for Grid communication
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### DOCUMENT CONTROL SHEET

DOCUMENT : TECHNICAL SPECIFICATION OF IT DEVICES FOR GRID COMMUNICATION

DOCUMENT NO. : BRPL-IT-SCADA-001

REV. NO. : 00

#### ENDORSEMENT

00	05.02.2019	First issue	Suman Kumar	Mrityunjay Kumar
Rev No.	Date	Description	GM - IT	HOD - IT
			Prepared by	Approved By
			BSES Rajdhani Power Limited	

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**POINTS TO BE CONSIDERED DURING DESIGNING OF NEW GRID****1.0 INTENT OF SPECIFICATION**

- 1.1 Tender Specification is intended to cover design, engineering, manufacture, assembly, inspection, shop testing, supply, packing, forwarding to site, unloading, storage and preservation, handling at site, insurance, erection & supervision of erection, pre-commissioning, testing & commissioning, completion of facilities, conducting reliability run tests and performance guarantee tests and handing over the complete IT system to IT department of BSES Rajdhani power limited.

The scope shall also cover the following activities and services in respect of all the equipment and works specified in various sections of this specification.

- a) Basic engineering of all equipment and equipment systems.
- b) Detailed design of all the equipment and equipment system(s).
- c) Providing engineering drawings, data, instruction manuals, as built drawings and other information for owner's review, approval and records.
- d) Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required.
- e) Complete manufacturing including shop testing.
- f) Packing and transportation from the manufacturer's works to the site including customs clearance, port charges, if any.
- g) Receipt, movement to proper storage, storage, preservation and conservation of equipment at the site, movement from storage area to interim/ final foundation location.
- h) Supply of spares as per specified list.
- i) All items and equipment though not specifically mentioned in the specification, but needed to complete the system to meet the intent of the specification shall be deemed to be included in the scope of the bidder.

It is not the intent to completely specify all details of design and construction, but only to lay down broad sizing and quality criteria for the major equipment and systems and it is expected that the equipments shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the contractor's guarantee in a specified manner acceptable to the owner.

## 2.0 SCOPE OF SUPPLY AND SERVICES

The scope of supply and services shall be complete but not limited to the following:

### 2.1 IT RACK ROOM REQUIREMENT

- 2.1.1 Air conditioned room shall be provided for proper functioning of all IT devices. The temperature shall be maintained to 22<sup>0</sup> to 24<sup>0</sup> C
- 2.1.2 Room size shall be minimum as –
  - a) Length – 3.5 mtrs
  - b) Width – 2.5 mtrs.
  - c) Height – 3 mtrs.
- 2.1.3 Cable trench/ duct – 200mm wide cable trench/ duct shall be provided below the finished floor for proper routing of cables up to IT rack. 100mm size conduit shall be provided for cable entry from outside of the building to inside cable trench/ duct. The cable trench / duct shall be connected to nearest DCDB for proper power cable routing up to IT rack.
- 2.1.4 Room door width shall be minimum 4 ft. for ease of rack entry and height shall be as per standard norms. Door shall have locking arrangement.
- 2.1.5 Room's front side shall be provided with glass partition to have the clear view of IT rack from outside the room.
- 2.1.6 Towers (2nos.) for communication link shall be installed at the roof the building. The area required for base of the tower shall be 5 ft X 5 ft and the tower load shall be maximum 250 kg. Link shall be delivered by RCOM/ Airtel/ Sify ISPs. These links delivery shall be directly taken care by owner. Bidder to provide the suitable platform as motioned in the clause for tower erection.

### 2.2 POWER SUPPLY REQUIREMENTS

- 2.2.1 Required power supply for communication devices inside the IT rack shall be provided. Two numbers 48V DC power through suitable MCB shall be provided for owner's use in the IT rack this power supply shall be used for communication link's POE devices.
- 2.2.2 All internal wiring of rack for various ratings of power supply required by other devices i.e switch, routers, cooling fan, light etc shall be provided.
- 2.2.2 All communication equipments/ devices inside the IT rack shall be on DC supply .

### 2.3 EARTHING REQUIREMENTS

- 2.3.1 Dedicated electronic earthing shall be provided for IT rack and their devices. The earth pit resistance should be between 0.6 ohm to 1 ohm.

- 2.3.2 Electronic Earthing cable from earth pit to IT rack shall be of minimum 16 sq.mm multi stranded copper cable PVC insulated and internal devices shall be done with minimum of 06 sq.mm multi stranded copper cable PVC insulated.

## 2.4 IT RACK SPECIFICATION

- 2.4.1 The design of IT rack and layout of all equipment, terminal blocks etc. shall be based on human engineering considerations, fully keeping in view the convenience of operation and maintenance personnel and shall be subject to Owner's approval during detailed engineering.
- 2.4.2 Rack shall be free standing type and have bottom/ top entry for cables to be decided application wise during detailed engineering. The bottom of rack shall be sealed with bottom plate, double compression cable glands and fire proof sealing material to prevent ingress of dust and propagation of fire.
- 2.4.3 Rack size shall be 12U and made of CRCA sheet with 1.6 mm thickness. The rack shall be of front and back opening with 2 mm thick door frame. Front and back door shall have full length of 3 mm thick glass panel for clear view of inside equipments. Cable gland plate shall be detachable type and of 2mm thickness. Door hinges and locks shall be as per manufacturer standards. Special key type locks are not acceptable. Rack colour shade shall be powder coated RAL 7035.
- 2.4.4 Two nos. adjustable height tray shall be provided in the rack for routers and ISP devices.
- 2.4.5 Following are the minimum equipment/ accessories shall be provided in the rack however same shall be decided during detail engineering –
1. DC Power supply converter -
    - i) Input source – 48V DC – 1 no.
    - ii) Output – 12V DC - 4 nos., 5VDC – 2 nos.
    - iii) Input and output connection shall be of terminal type.
    - iv) Input terminals - suitable for 4 sq.mm cable
    - v) Output terminals - suitable for 2.5 sq.mm cable
  2. AC power supply extension board -
    - i) Input source – 230V AC – 1 no.
    - ii) Output sockets with individual switch – 230V AC – 5 nos.
  3. Rack Fan and filter – size 6"
  4. MCB and Terminal blocks – MCB DP type and terminals shall be mounted on DIN rail. Minimum four nos. MCB shall be provided in the rack. One no. for 48 V DC (20A), one no.

for 230V AC (10A) and one no. of each rating shall be kept as spare. Terminal blocks shall be fused type and suitable to respective voltage rating and intended cable size mentioned elsewhere in the specification.

2.4.6 All inter panel wiring shall be with FRLS type wires with proper routing inside the cable alley. Cross ferruling shall be provided for easy identification of wires. Cable shall have proper cable tagging.

2.4.7 Panel name plate shall be provided at top portion of front and back doors. It shall be engraved type and made of acrylic plate.

## 2.5 IT devices

2.5.1 Router – Router shall have minimum 2 nos. WAN ports and 8 nos. LAN port. Router shall also support the 3G/ 4G dongle connectivity.

2.5.2 Switch – Switch shall have minimum 12 LAN ports. Switch shall be provided with all mounting accessories.

## 3.0 Terminal Points

3.1 Power supply – From PDB to IT rack including cable supply, erection and termination at both end (PDB and IT rack). PDB details shall be part of Electrical section of technical specification

3.2 LAN cabling – From RTU to IT rack router/ switch including CAT 6 cable (armour type) supply, erection and termination at both end (RTU and IT rack).

3.3 Communication link – Shall be provided by respective ISP upto router WAN ports.

## 4.0 Exclusions –

4.1 Communication tower and link.

## 5.0 Bill of Quantity and vendor list of each item per rack for each grid –

Sr. No.	Item Description	Make / Model No.	Quantity (in nos.)
1	Rack – 12U	Rittal / Pyrotech	01
2	Router	Fortigate / CISCO	01
3	Switch	CISCO	01
4	Power Supply converter	Meanwell/ Phoenix	01
5	MCB	Havells / Legrand	04
6	Terminal blocks	Wago/ phoenix	1 lot

7	AC extension board	Havells / Anchor	1
8	Wires for Internal wiring	RR cable, Finolex, Havells	1 lot
9	Spare Terminal blocks with fuses (mounted in the rack)	Wago/ phoenix	20%
10	Terminal fuses of each rating (loose supply)		20%



**TECHNICAL SPECIFICATION**

**FOR**

**CABLE SEAL SOLUTION**

Specification No- SP-GMS-01-R0

Prepared by	Javed Ahmed		Rev: 0
Reviewed by	Abhinav Srivastava		
Approved by	Sheshadri Krishnapura		Date: 16 <sup>th</sup> April 2018

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Registered Office: BSES Bhavan, Nehru Place, Delhi - 110019

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5.0	Installation, Testing and Commissioning
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**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 Aluminum (Grade EN AC 44300)/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	2 copies + 1 soft copy

	copy specification	of	
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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	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.
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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	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
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		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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**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 TRAINING AND INSPECTION**

Prepared by	Anupam Kumar		Rev: 1
Reviewed by	Abhinav Srivastava		Date: 19.04.2017
Approved by	Vijay Panpalia		

## Volume – I Technical Specification for Training and Inspections

### Training and Inspection

The Scope includes training and inspection of BRPL Officials at site and at OEM's factory on overall product and all its sub-components. Cost of travel by flight and

#### 1. Training of BRPL officials

The Scope includes training of BRPL Officials at site and at OEM's factory on overall product and all its sub-components.

BRPL official will include departmental personnel from Operation & Maintenance, Protection, SCADA and Engineering.

Training will include, but not limited to, verbal and written communication on aspects ranging from operation, maintenance, safety, features and functions.

It will be the responsibility of contractor to arrange the following:

- i) To arrange Air travel and Taxi for local conveyance at the contractors cost for the engineers/ officers deputed for carrying out the inspection of the material.
- ii) To arrange the minimum 4 star accommodation at the contractors cost for the boarding/ lodging and meals thereof for the engineers/ officers deputed for carrying out the inspection of the material.
- ii) To depute his competent representative to impart training of the material.

Following Table defines mandays required for training of each equipment.

S. No.	Equipment	Training at Site (No. of Days)	Training at Factory (No of Days)	No. of BRPL Representatives for Factory Visit
1	C&R Panels	6	2	3
2	11 kV Panels	3	2	3
3	SCADA – RTU	3	2	2
4	Battery Bank	1	1	1
5	Battery Charger	1	1	1
6	11kV APFC with Controller	3	2	3
7	Fire suppression System	1	0	0
8	Video Surveillance System	1	0	0
9	Fire Detection System	1	0	0
10	66kV Isolator	1	0	0
11	CT, PT and CVT	1	0	0

## **Volume – I Technical Specification for Training and Inspections**

### **2. Inspection & Testing**

#### **2.1 Independent Inspection**

BRPL may at his discretion delegate inspection and testing of material to an independent inspector.

#### **2.2. Dates for Inspection and Testing**

The Contractor shall give the Owner reasonable notice (minimum 10 days) in writing of the date and the place at which any material will be ready for testing as provided in the Contract and Owner shall attend at the place so named within fifteen (15) days of the date, which the Contractor has stated in his notice. The Owner shall give the Contractor twenty four (24) hours notice in writing of his intention to attend the tests. The above notices shall be given at first by the quickest possible means and confirmed later in writing.

If on receipt of the Contractor's notice of testing, the Owner's representative does not find the material to be ready for testing, the costs incurred for re-deputation of inspector and re-inspection shall also be in Contractor's Scope.

#### **2.3 Inspection charges:**

Detailed breakup of no. of inspectors for each inspection is as under.

<b>S.No</b>	<b>Equipment</b>	<b>No of Inspectors</b>
1	CRP	3
2	RTU	2
3	HT Panels	2
4	For all other equipments	1
5	For all Stage inspections	1

It will be the responsibility of contractor to arrange the following:

i) Cost of all the inspections within India and abroad (including re inspections) including flight Tickets, local conveyance, Boarding and lodging (Minimum 4 Star Hotel for India and Minimum 5 Star for Abroad) shall be in scope of Vendor. The Factory visits will be held at OEM Factory only.

ii) To depute his authorized representative to associate during the inspection of the material.

In case of fake call or rejection of material or any other cause, the Owner is

## **Volume – I Technical Specification for Training and Inspections**

not liable for reimbursement of the expenditure so incurred by the contractor.

### *2.4 Rejection*

If as-a-result of the inspection, examination or testing as per approved QAP, the Owner decides that any equipment is defective or otherwise not in accordance with the Contract, he may reject such equipment and shall notify the Contractor there-of, immediately. The notice shall state the Owner's objections with reasons.

The Contractor shall then with all speed make good the defect or ensure that any rejected equipment complies with the Contract.

If the Owner requires such Equipment to be re-tested, the tests shall be repeated under same terms and conditions. All costs incurred for re-deputation of inspector and re-inspection shall also be in Contractor's Scope.



# **TECHNICAL SPECIFICATION**

## **APPROVED MAKES & VENDORS**

Prepared by	Abhinav Srivastava		Rev: 1
Reviewed by	k.Sheshadri		Date: 22.07.2018
Approved by	k.Sheshadri		

## Volume-I Technical Specification for Approved Makes & Vendors

### 1.0 APPROVED MAKES & VENDORS

S NO.	Vendors
<b>1.0</b>	<b>Power Transformer</b>
1.1	BHARAT BIJLEE LIMITED
1.2	ABB LIMITED
1.3	SCHNEIDER ELECTRIC LIMITED.
1.4	BHEL
1.5	CGL
<b>2.0</b>	<b>Station Transformers</b>
2.1	SCHNEIDER ELECTRIC LIMITED.
2.2	TOSHIBA
2.3	DANISH
2.4	CGPISL
<b>3.0</b>	<b>LT Control, Communication and special cables</b>
3.1	POLYCAB
3.2	PARAMOUNT COMMUNICATIONS LIMITED
3.3	TARUNA METALS PVT. LIMITED.
3.4	ALPHA COMMUNICATION
3.5	KEI INDUSTRIES LIMITED.
<b>4.0</b>	<b>LT(1.1 KV grade) XLPE Insulated Power Cables</b>
4.1	PARAMOUNT COMMUNICATIONS LIMITED
4.2	KEI INDUSTRIES LIMITED.
4.3	HINDUSTAN VIDYUT PRODUCTS LIMITED
4.4	GEMSCAB INDUSTRIES LIMITED
4.5	KRISHNA ELECTRICAL INDUSTRIES LIMITED
4.6	POLYCAB WIRES PRIVATE LIMITED
4.8	KEC INTERNATIONAL LIMITED (RPG CABLES LIMITED )
4.9	HAVELLS
<b>5.0</b>	<b>11KV 500MVA Indoor Switchboard</b>
5.1	SIEMENS LIMITED
5.2	ABB LIMITED
5.3	SCHNEIDER ELECTRIC LIMITED.
<b>6.0</b>	<b>66KV Outdoor Circuit Breakers</b>
6.1	ABB LIMITED
6.2	SIEMENS LIMITED
6.3	GE
6.4	CGPISL
<b>7.0</b>	<b>66KV &amp; 11KV Outdoor CT/PT</b>
7.1	CROMPTON GREAVES LIMITED
7.2	KAPCO ELECTRIC PVT. LIMITED.

## Volume-I Technical Specification for Approved Makes & Vendors

7.3	GE
7.4	MEHRU ELECTRICAL & MECHANICAL ENGINEERS P LIMITED.
7.5	ABB LIMITED
7.6	BHEL
<b>8.0</b>	<b>CVT</b>
8.1	CROMPTON GREAVES LIMITED
8.2	ABB LIMITED
8.3	MEHRU
8.4	GE
8.5	SIEMENS
<b>8.0</b>	<b>33&amp;66KV Lightening Arrestor</b>
8.1	ALSTOM
8.2	OBLUM ELECTRICAL INDUSTRIES PVT. LIMITED.
8.3	LAMCO INDUSTRIES PVT. LIMITED.
8.4	ABB LIMITED
8.5	CROMPTON GREAVES LIMITED.
8.6	ELECTROLYTE
8.7	RAYCHEM
<b>9.0</b>	<b>66KV Isolators</b>
9.1	ABB LIMITED.
9.2	SIEMENS LIMITED.
9.3	CROMPTON GREAVES LIMITED.
<b>10.0</b>	<b>66KV Control &amp; Relay Panel</b>
10.1	ABB LIMITED.
10.2	SCHNEIDER ECLECTRIC LIMITED.
10.3	SIEMENS LIMITED.
<b>11.0</b>	<b>11KV Capacitor Bank</b>
11.1	UNIVERSAL CABLES LIMITED.
11.2	SHREEM ELECTRIC LIMITED
11.3	ABB LIMITED
11.4	LARSEN & TOUBRO LIMITED
11.5	EPCOS INDIA PVT. LIMITED
<b>12.0</b>	<b>ACDB &amp; BMK</b>
12.1	NEPTUNE
12.2	CMKL
12.3	NEC
12.4	EATHUN
12.5	POPULAR SWITCHGEAR
12.6	SHIVALIC

## Volume-I Technical Specification for Approved Makes & Vendors

<b>13.0</b>	<b>St. through jointing and Termination Kits – 1.1KV,11KV</b>
13.1	RAYCHEM RPG LIMITED
13.2	3M ELECTRO & COMM. INDIA (P) LIMITED.
13.3	DENSON
<b>14.0</b>	<b>St. through jointing and Termination Kits – 66KV</b>
14.1	RAYCHEM RPG LIMITED
14.2	3M ELECTRO & COMM. INDIA (P) LIMITED.
<b>15.0</b>	<b>LED/HPSV/Fluorescent Lamps, Ballasts, Starters / Igniters, Fittings, Lamp Holder</b>
15.1	PHILIPS ELECTRONICS INDIA LIMITED
15.2	CROMPTON GREAVES LIMITED
15.3	BAJAJ ELECTRICALS LIMITED
15.4	SURYA ROSHNI LIMITED
<b>16.0</b>	<b>Transformer oil</b>
16.1	APAR INDUSTRIES LIMITED
16.2	SAVITA OIL TECHNOLOGIES LIMITED
16.3	RAJ PETRO SPECIALITIES PVT. LIMITED.
<b>17.0</b>	<b>Protective Relays (Refer Technical specification for details)</b>
17.1	SIEMENS LIMITED
17.2	A-EBERLE
17.4	ABB LIMITED
17.5	SCHNEIDER ELECTRIC
17.6	GE
<b>18.0</b>	<b>Overhead Line accessories e.g. Clamps, Connectors, Line Hardware fitting</b>
18.1	RAYCHEM RPG PVT.LIMITED
18.2	RASHTRA UDHYOG LIMITED.
18.3	KLEMMEN ENGINEERING
18.4	LEGION
18.5	BURMA
<b>19.0</b>	<b>Disc and Pin Insulators</b>
19.1	ADITYA BIRLA INSULATORS
19.2	MORDEN INSULATORS LIMITED.
19.3	BHEL
19.4	IEC
19.5	W.S. INDUSTRIES
<b>20.0</b>	<b>STEEL TUBULAR POLES</b>
20.1	FABRICO (INDIA) PVT. LIMITED.
20.2	ADVANCE STEEL TUBES LIMITED.
20.3	GOOD LUCK STEEL TUBES LIMITED.

## Volume-I Technical Specification for Approved Makes & Vendors

20.4	RAMA STEEL TUBES LIMITED.
<b>21.0</b>	<b>ACSR Conductors</b>
21.1	HINDUSTAN VIDYUT PRODUCTS LIMITED
21.2	GUPTA POWER
21.3	LUMINO INDUSTRIES LIMITED
21.5	POLYCAB WIRES PRIVATE LIMITED
<b>22.0</b>	<b>Battery Bank</b>
22.1	PANASONIC
22.2	SAMSUNG
22.3	OKAYA
22.4	COSTLITE
<b>23.0</b>	<b>Battery Charger cum DC DB</b>
23.1	MASS-TECH CONTROLS PRIVATE LIMITED
23.2	CALDYNE AUTOMATICS LIMITED.
23.3	CHABI ELECTRICALS
<b>24.0</b>	<b>PAINTS &amp; CHEMICALS</b>
24.1	BERGER PAINTS INDIA LIMITED BRITISH PAINTS DIVISION
24.2	SHALIMAR PAINTS LIMITED.
24.3	NEROLAC PAINTS LIMITED.
24.4	ASIAN PAINTS LIMITED.
<b>25.0</b>	<b>CEMENT</b>
25.1	ACC
25.2	ULTRA TECH
<b>26.0</b>	<b>STEEL</b>
26.1	TATA
26.2	SAIL
<b>27</b>	<b>NIFPS</b>
27.1	CTR
<b>28</b>	<b>HIGH MAST</b>
28.1	BAJAJ ELECTRICALS LTD.
<b>29</b>	<b>CABLE SEAL</b>
29.1	ROXTEC
29.2	MCT Brattberg
<b>30</b>	<b>EOT Crane</b>
30.1	REVA
30.2	DEMAG
31	GIS Gas Handling kit(Gas filling, filter and evacuation kit)
31.1	DILO

## **VOLUME – II**

### **SCHEDULE AND ANNEXURE**

**SCHEDULE – A**  
**GENERAL PARTICULARS**

(This shall form part of Technical Bid)

**1.0 Bidder**

- |     |  |   |
|-----|--|---|
| 1.1 | Name   | : |
| 1.2 | Postal Address   | : |
| 1.3 | Telegraphic Address  | : |
| 1.4 | Telex number / Answer back code  | : |
| 1.5 | Phone(s)   | : |
| 1.6 | Name and Designation of the person who should be contacted in case of clarifications / details etc. not received expeditiously from the officer mentioned in item 1.6 above  | : |
| 1.7 | Brief write-up giving details of the organization, years of establishment and commercial production activities, manufacturing, fabrication, shop testing, erection, testing, commissioning and after-sales service facilities, key personnel with their qualifications and experience, collaboration agreements, if any number of employees in various categories and last three (3) years turn over | : |

<b>2.0</b>	Bid Validity	:
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<b>3.0</b>	All the Schedules filled-in	:	Yes
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<b>4.0</b>	All the Deviations brought out in Schedule – E1 and E2	:	Yes
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<b>5.0</b>	All the drawings, write-ups, literature, leaflets, calculations, details, etc as called for in the specification attached	:	Yes
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<b>6.0</b>	Is the Bidder agreeable to undertake this contract, if deviations stipulated by him are not acceptable to the Purchaser	:	Yes/No
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**Volume – 2 Schedules & Annexure**

**Schedule A**

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_



**SCHEDULE – B1**  
**11KV INDOOR SWITCHGEAR**

Sr. No.	Description	Incomer	Bus coupler	Outgoing	Capacitor	Transformer
<b>1</b>	<b>Switchgear assembly</b>					
1.1	Make					
1.2	Type					
1.3	Reference standard					
1.4	Voltage (normal / Max. KV)					
1.5	Frequency (HZ)					
1.6	Short circuit rating					
1.7	Short time current and duration					
A	Impulse withstand (KV peak)					
B	1min. Power freq. withstand test(KV rms)					
<b>2</b>	<b>Construction</b>					
2.1	Metal clad construction (Yes / No)					
2.2	Degree of Portion					
2.3	Minimum thickness of sheet metal used (mm)					
2.4	Draw out feature provided for					
A	Breaker with service, test & isolated position - Yes /No					
B	Voltage Transformer- Yes / No					
C	Protection relays -Yes /No					
2.5	Breaker cubicle					
A	Cubical door can be closed with breaker in test and isolated position -Yes / No					
B	Working zone units from floor level (mm)					
2.6	All meters, switchgear & relays flush mounted type -Yes /No					
2.7	Minimum clear space required					
A	Front for breaker withdrawal (mm)					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

B	Rear (mm)					
2.8	Typical vertical section					
A	Overall dimensions					
	i. Length (mm)					
	ii. Breath (mm)					
	iii. Height (mm)					
B	Weight (Kg)					
<b>3</b>	<b>Bus Bar</b>					
3.1	Make					
3.2	Material & grade					
3.3	Reference standard					
3.4	Cross section area (mm <sup>2</sup> )					
3.5	Bus connection (joints)					
A	Silver plated -Yes /No					
B	Conventional made with anti oxide grease -Yes /No					
3.6	Rated continuous current amps					
3.7	Maximum temp. rise at rated continuous current DFG C					
3.8	Short time current and duration KA ... secs					
3.9	DC resistance at 85 DEG C ( $\Omega/m/\varnothing$ )					
3.10	Minimum clearance of bus bar and connection					
A	Phase to phase (mm)					
B	Phase to earth (mm)					
3.11	Bus bar provided with					
A	Insulation sleeve					
B	Phase barriers					
C	Cast resin shrouds for joint					
3.12	Bus bar supported spacing (mm)					
3.13	Bus bar insulators					
A	Make					
B	Type					
C	Reference standard					
D	Voltage class (KV)					
E	Min. creepage distance (mm)					
F	Cantilever strength Kg/mm <sup>2</sup>					
G	Net weight (Kg)					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

<b>4</b>	<b>Circuit Breaker</b>					
4.1	Make					
4.2	Type					
4.3	Reference standard					
4.4	Related Voltage					
4.5	Related frequency					
4.6	Related current and its reference ambient temp					
A	Continuous current to limit the max. temp. rise to 55DEG C for silver plated connections and 40DEG C for conventional connections					
4.7	Related operating duty					
4.8	Symmetrical breaking capacity at rated voltage & operating duty KA rms.					
4.9	Rated making current (Kap)					
4.10	Short time current and duration KA ... secs					
4.11	Insulation level					
A	Impulse voltage withstand on 1/50 full wave					
A	1min. Power freq. withstand test(KV rms)					
4.12	Maximum overvoltage factor while switching off					
A	Un loaded transformer					
B	Loaded transformer					
C	Un loaded CABLES					
D	Capacitor					
E	Motors					
4.13	Opening time max. No load condition (ms)					
4.14	Number of permissible breaker operation under vacuum loss					
4.15	At 100% breaking capacity					
A	Opening time Max. (ms)					
B	Arcing time max (ms)					
C	Total break time (ms)					
4.16						
A	Make time (Max) (ms)					
B	Total closing time (ms)					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

4.17	Total length of contact travel (mm)					
4.18	No. of breaker operation permission without requiring inspection, replacement of contacts and other main parts.					
A	At 100% rated current					
B	At 100% rated breaking current					
4.19	Types of contents					
4.20	Maximum clearance in air (mm) from live part					
4.21	Between phases					
A	Between live parts and ground					
B	Type of arc control device provided					
4.22	Operating mechanism closing					
4.23	Type					
A	No. of breaker operations stored					
B	Trip free or fixed trip					
C	Anti pumping features provided					
4.24	Operating mechanism tripping					
A	Type					
B	No. of breaker operations stored					
C	Trip free or fixed trip					
D	Anti pumping features provided					
4.25	Spring charging motor					
A	Rating					
B	Make					
C	Voltage and permissible variation(%)					
4.26	Closing coil					
A	Voltage (V)					
B	Permissible voltage variation (%)					
C	Closing current at rated voltage (A)					
D	Power at rated voltage (w)					
4.27	Trapping Coil					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

A	Voltage (V)					
B	Permissible voltage variation (%)					
C	Tripping current rated voltage (A)					
D	Power at rated voltage (w)					
4.28	Breaker / Accessories Accessories such as control switch indication lamps etc. furnished as specified. (Please attach separate sheet giving details of all Accessories, inter locks and safety shutters)					
A	Mechanical safety interlock					
B	Automatic safety interlock					
C	Operational interlock					
D	Emergency manual trip					
E	Operation counter					
F	Change / discharge indicator					
G	Manual spring charging facility					
H	Auxiliary switch with 6 No + 6 NC for owner's use					
I	Contacts wear indicator					
4.29	Auxiliary Switch					
A	Switch contacts type					
B	Contacts rating at					
	1) Make & Continuous (Amps)					
	2) Break (Inductive) (Amps)					
4.30	Net weighting of the breaker (Kg)					
4.31	Impact load foundation design ( to include dead load plus impact value on opening at maximum interrupting rating) (Kg)					
4.32	On vacuum loss (Amps)					
A	Possible load current breaker (Amps)					
B	Possible fault current breaker (Amps)					
4.33	Overall dimensions					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

A	Length (mm)					
B	Breath (mm)					
C	Height (mm)					
4.34	Type test report omidentical breaker furnished					
<b>5</b>	<b>Control &amp; Indications</b>					
5.1	Push Button Make					
A	Type & Catalog No.					
B	Contact rating at 110V/220V.D.C					
C	Make & continuous (Amps)					
5.2	LED lamps: Make:					
A	Type & Catalog No.					
B	Watts /Voltage					
C	Lamps & lens replaceable from front with glass cover					
5.3	Selector switch: Make:					
A	Type & Catalog No.					
B	Contact rating					
C	Make & continuous (Amps)					
D	Break (Inductive)(Amps)					
<b>6</b>	<b>Current Transformer</b>					
6.1	Make					
6.2	Types & Voltage Level					
6.3	Reference standard					
6.4	C.T ratio as specified					
6.5	Short circuit withstand short time current for 1 sec. - KA rms Dynamic current -KA peak					
6.6	Class of insulation					
6.7	Temperature rise					
6.8	Basic insulation level					
6.9	For metering & protection					
A	CT ratio					
B	Class of accuracy					
C	Rated burden VA					
D	Knee point voltage V					
E	Excitation current at $V_K / 4$					
F	Rated saturating current Amp					
6.10	For differential & restricted earth fault protection					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

A	CT ratio					
B	Class of accuracy					
C	Rated burden VA					
D	Knee point voltage V					
E	Excitation current at $V_K / 4$					
F	Rated saturating current Amp					
6.11	For restricted earth fault protection					
A	CT ratio					
B	Class of accuracy					
C	Rated burden VA					
D	Knee point voltage V					
E	Excitation current at $V_K / 4$					
F	Rated saturating current Amp					
G	Secondary resistance ( $\Omega$ )					
6.12	For stand by earth fault protection					
A	CT ratio					
B	Class of accuracy					
C	Rated burden VA					
D	Knee point voltage V					
E	Excitation current at $V_K / 4$					
F	Rated saturating current Amp					
G	Over current rating continuous % over load (%)					
6.13	For sensitive by earth fault protection (CBCT)					
A	CT ratio					
B	Class of accuracy					
C	Rated burden VA					
D	Knee point voltage V					
E	Excitation current at $V_K / 4$					
F	Rated saturating current Amp					
G	Over current rating continuous % over load (%)					
<b>7</b>	<b>Potential Transformer</b>					
7.1	Make					
7.2	Types & Voltage Level					
7.3	Reference standard					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

7.4	Voltage ratio					
7.5	Accuracy					
A	Corer-1					
B	Corer-2					
7.6	Rated burden					
A	Corer-1					
B	Corer-2					
7.7	Over voltage factor					
A	Continuous					
B	30 Seconds					
7.8	Class of insulation					
7.9	Temperature rise over ambient ( ° C)					
7.10	Basic impulse level (KV peak)					
7.11	Winding connection					
A	Primary					
B	Secondary					
7.12	Fuses					
A	Continuous rating HV / LV (Amp)					
B	Symmetrical fault rating HV /LV KA rms					
C	Make					
7.13	Maximum ratio error at					
A	90% to 100% of rated voltage and 25% to 100% of rated secondary burden at unity power factor					
B	90% to 106% of rated voltage and 10% to 50% of rated secondary burden at 0.2 p.f.					
7.14	Maximum Phase difference at					
A	90% to 106% of rated voltage and 10% to 50% of rated secondary burden at 0.2 p.f.					
B	90% to 106% of rated voltage and 10% to 50% of rated secondary burden at 0.2 p.f.					
7.15	E=Weight (Kg)					
<b>8</b>	<b>Relay</b>					
8.1	Manufacture					
8.2	Model Type					



**Volume – 2 Schedules & Annexure**

**Schedule B1**

8.3	Draw out type with built in test facilities. Yes/ No					
8.4	Built in test facility Yes /No					
8.5	Type of mounting					
8.6	Reference standard					
8.7	All relays furnished as per drawing and specification					
8.8	All relevant relay leaflets and catalogue furnished					
8.9	Communication port type					
8.10	Auxiliary Supply					
8.11	Measurement and data acquisition feature					
8.12	Control and supervision					
A	IEC protocol					
B	Open protocol feature					
C	Programming facility					
D	Separate output for individual element					
E	Event recording facility number of events					
F	Required software offered					
8.13	C.T.secondary current					
8.14	Self diagnostic feature					
8.15	Modular design					
8.16	Relay details					
8.16.1	Over current					
A	Make					
B	Type					
C	Characteristic available					
D	Range of setting i. Current ii. Time					
E	Range of setting i. Current ii. Time					
F	Rated burden					
8.16.2	Synchronizing check relay					
A	Make					
B	Type					
C	Setting range					
8.16.3	Earth fault					
A	Make					
B	Type					
C	Characteristic available					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

D	Range of setting i. Current ii. Time					
E	Rated burden					
8.16.4	Over current (Directional)					
A	Make					
B	Type					
C	Characteristic available					
D	Range of setting i. Current ii. Time					
E	Rated burden					
8.16.5	Earth fault (Directional) if applicable					
A	Make					
B	Type					
C	Characteristic available					
D	Range of setting i. Current ii. Time					
E	Rated burden					
8.16.6	Neutral unbalance relay					
A	Make					
B	Type					
C	Characteristic available					
D	Range of setting i. Current ii. Time					
E	Rated burden					
8.16.7	Under voltage relay					
A	Make					
B	Type					
C	Range of setting i. Current ii. Time					
D	Rated burden					
8.16.8	Over voltage relay					
A	Make					
B	Type					
C	Range of setting i. Current ii. Time					
D	Rated burden					
8.16.9	Busbar differential relay					
A	Make					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

B	Type					
C	High impedance / low impedance					
D	Facility of CT ratio adjustment possible through software. Yes / No					
E	CT supervision facility available. Yes /No					
8.16.10	Transformer differential relay					
A	Make					
B	Type					
C	High impedance / low impedance					
D	Facility of CT ratio adjustment possible through software. Yes / No					
E	Facility of transformer vector group adjustment possible through software. Yes/ No					
F	Setting range					
G	Rated burden					
8.16.11	Restricted earth fault relay					
A	Make					
B	Type					
C	Combined with differential relay. Yes / No					
D	Setting range					
E	Rated burden					
8.16.12	Stand by earth fault relay					
A	Make					
B	Type					
C	Characteristics					
D	Setting range					
E	Rated burden					
<b>9</b>	<b>Meters</b>					
9.1	ammeter					
A	Make					
B	Type					
C	Reference standard					
D	Size					
E	Scale					
F	Accuracy class					
9.2	Voltmeter					
A	Make					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

B	Type					
C	Reference standard					
D	Size					
E	Scale					
F	Accuracy class					
9.3	Energy Meter					
A	Make					
B	Type					
C	Reference standard					
D	Size					
E	Scale					
F	Accuracy class					
G	Measurement					
H	kWh					
I	kVARh					
J	kVAh					
K	Any Other					
L	Data stored capability					
M	Pulse output facility					
N	Data down loading facility					
<b>10</b>	<b>Secondary Wiring</b>					
10.1	Type of insulation					
10.2	Voltage grade					
10.3	Conductor material					
10.4	Conductor Size (minimum) and insulation wiring					
A	Potential circuit					
B	Control & current circuit					
<b>11</b>	<b>Terminal Block</b>					
11.1	Make					
11.2	Type					
11.3	Catalog No.					
11.4	20% spare terminal furnished					
<b>12</b>	<b>Cable Termination</b>					
12.1	Clearance for power cable termination					
12.2	Removable gland plate					
A	Material for multicore cable					
B	Material for single core cable					
C	Thickness of plate					
<b>13</b>	<b>Name Plate</b>					
13.1	Material					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

13.2	Thickness					
13.3	Size for					
A	Breaker cubicle					
B	Instrument / devices					
<b>14</b>	<b>Space heater / plug socket</b>					
14.1	Cubicle heater					
A	Thermostat controlled					
B	Wattage					
C	Voltage					
D	Resistance (ohms)					
E	Thermostat range					
14.2	Plug Socket					
A	Type					
B	Rating					
14.3	Cubical heater & plug socket circuit provided with MCB's					
<b>15</b>	<b>A.C. /D.C. Supply</b>					
15.1	Isolated switches for incoming supply					
A	A.C. Type & rating					
B	D.C. Type & rating					
15.2	Isolated switches at each cubicle					
A	A.C. Supply type & rating					
B	D.C. Supply type & rating					
<b>16</b>	<b>Tropical Protection</b>					
16.1	Any Special treatment for tropical protection					
<b>17</b>	<b>Painting</b>					
17.1	Finish of switchgear					
A	Inside					
B	Outside					
<b>18</b>	<b>No. of Accessories furnished</b>					
A	Breaker lifting & handling trolley					
B	Any other					
<b>19</b>	<b>Tests</b>					
19.1	Reference standard					
19.2	Routine test to be performed on switchgear					
19.3	Type test certificates submitted					
<b>20</b>	<b>Drawing / Data</b>					

**Volume – 2 Schedules & Annexure**

**Schedule B1**

20.1	General arrangement for panel board					
20.2	Foundation Panel					
20.3	Bill of material					
20.4	Cross sectional drawing for every type of switchgear (Add sheets if necessary)					

	Bidders Name	:	_____
	Signature	:	_____
	Name	:	_____
	Designation	:	_____
Seal of Company	Date	:	_____

**SCHEDULE – B2**  
**66 kV CONTROL & RELAY PANEL**

	Parameter	Technical Particulars	
<b>1.00.00</b>	<b>CONTROL PANEL BOARD</b>		
1.01.00	Make		
1.02.00	Type		
1.03.00	Reference Standard		
1.04.00	Construction		
1.04.01	Degree of protection		
1.04.02	Sheet metal thickness mm		
1.04.03	Floor channel sills, vibration damping pads and kick plate furnished?		
1.05.00	Equipment Mounting		
1.05.01	All relays, meters and switches are flush mounted?		
1.05.02	Relays furnished in draw out cases with built in test facilitate?		
1.06.00	Name plate		
1.06.01	Material		
1.06.02	Thickness		
1.06.03	Size for:-		
	Equipment		
	Panels		
1.07.00	Mimic		
1.07.01	Material		
1.07.02	Width		
1.08.00	Internal Illumination		
1.08.01	Volt		
1.08.02	Watt		
1.08.03	Door switched controlled		
1.09.00	Space Heater		
1.09.01	Volt		
1.09.02	Watt		
1.09.03	Thermostat Controlled?		
1.10.00	Plug Socket		
1.10.01	Type		
1.10.02	Rating		
1.11.00	Panel Illumination, space heater & plug socket circuits provided with individual switch fuse units?		
1.12.00	AC/DC Supply - Type & rating of isolating switch fuse units for		
1.12.01	Incoming AC Supply		
1.12.02	Incoming DC Supply		
1.13.00	Internal Wiring		
1.13.01	Wire Type		
1.13.02	Voltage Grade		

**Volume – 2 Schedules & Annexure**

**Schedule B2**

1.13.03	Conductor Material		
1.13.04	Conductor Size for		
	i) Current / control circuit		
	ii) Voltage Circuit		
1.13.05	Wires identified at both ends with ferrules?		
1.14.00	Terminal block		
1.14.01	Make		
1.14.02	Type / Catalogue No		
1.14.03	20% spare terminals furnished?		
1.15.00	Ground Bus		
1.15.01	Materials		
1.15.02	Size (mm)		
1.16.00	Painting		
1.16.01	Type of finish		
1.16.02	Colour Shade - Inside/Outside		
1.16.03	Details of Painting procedure finished?		
<b>2.00.00</b>	<b>BREAKER CONTROL SWITCH</b>		
2.01.00	Make		
2.02.00	Type		
2.03.00	Reference Standard		
2.04.00	Contact Rating	220V DC	240V AC
2.04.01	Make & Continuous (A)		
2.04.02	Break (inductive) (A)		
<b>3.00.00</b>	<b>ISOLATING CONTROL SWITCH</b>		
3.01.00	Make		
3.02.00	Type		
3.03.00	Reference Standard		
3.04.00	Contact Rating	220V DC	240V AC
3.04.01	Make & Continuous (A)		
3.04.02	Break (inductive) (A)		
<b>4.00.00</b>	<b>METER SELECTOR SWITCH</b>		
4.01.00	Make		
4.02.00	Type		
4.03.00	Reference Standard		
4.04.00	Contact Rating	220V DC	240V AC
4.04.01	Make & Continuous (A)		
4.04.02	Break (inductive) (A)		
<b>5.00.00</b>	<b>PUSH BUTTON</b>		
5.01.00	Make		
5.02.00	Type		
5.03.00	Reference Standard		
5.04.00	Contact Rating		
5.04.01	Make & Continuous (A)		
5.04.02	Break (inductive) (A)		
5.05.00	NO & type of Contacts provided per button		
<b>6.00.00</b>	<b>LAMPS</b>		
6.01.00	Make		
6.02.00	Type		
6.03.00	Reference Standard		
6.04.00	Rating:		



**Volume – 2 Schedules & Annexure**

**Schedule B2**

6.04.01	Volt		
6.04.02	Watt		
6.04.03	Series Resistance		
6.05.00	10 % Extra lamps furnished?		
6.06.00	Size of lens		
<b>7.00.00</b>	<b>SEMAPHORE INDICATORS</b>		
7.01.00	Make		
7.02.00	Type		
7.03.00	Diameter of the Disc		
7.04.00	Operating voltage		
7.05.00	Burden (Watt DC)		
7.06.00	Whether latch in type or supply Failure type		
<b>8.00.00</b>	<b>INDICATING INSTRUMENT</b>	<b>Ammeter</b>	<b>Voltmeter</b>
8.01.00	Make		
8.02.00	Type		
8.03.00	Reference Standard		
8.04.00	Type of Movement		
8.05.00	Accuracy Class		
8.06.00	Scale in Degrees		
8.07.00	VA Burden		
<b>9.00.00</b>	<b>MULTIFUNCTION METER</b>		
9.01.00	Make		
9.02.00	Type		
9.03.00	Reference Standard		
9.04.00	Furnished in Draw out Case or not		
9.05.00	Type of Register		
9.06.00	Accuracy Class		
9.07.00	VA Burden		
9.07.01	Current Coil		
9.07.02	Voltage Coil		
<b>10.00.00</b>	<b>ANNUNCIATOR</b>		
10.01.00	Make		
10.02.00	Type		
10.03.00	Reference Standard		
10.04.00	No. of Annunciator groups furnished?		
10.05.00	No. of Windows per group		
10.06.00	Overall Dimension of a group (mm)		
10.07.00	Detailed Write-up on Scheme furnished?		
<b>11.00.00</b>	<b>TRANSDUCERS</b>		
11.01.00	Whether provided as per specification		
11.02.00	Make		
11.03.00	Type		
11.04.00	Output		
11.05.00	Accuracy		
11.06.00	Response Time		
11.07.00	Power Supply		
11.08.00	Isolation		
11.09.00	Catalogue furnished		

**Volume – 2 Schedules & Annexure**

**Schedule B2**

12.00.00	RELAYS	Make	Type
12.01.00	Relays furnished in draw out cases with built in test facilities?		
12.02.00	Line Protection Panel		
12.03.00	Transformer Panel		
12.04.00	Bus coupler Panel		
12.05.00	Miscellaneous Auxiliary Relays		
12.06.00	Auxiliary Relay, Voltage Operated with		
	4 pair of contacts		
	8 pair of contacts		
12.07.00	Auxiliary Relay, Current Operated with		
	4 pair of contacts		
12.08.00	Catalogue of all relays submitted with bid		

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

## SCHEDULE – B3

### Li\_Ion Battery

S.NO.	Description	Data to be filled by Manufacturer
1	Battery ( as per scope of supply annexure A) - Yes / No	
2	Manufacturing battery type	
3	Conformance to design standards as per specification clause no. 2.0 - Yes / No	
4	Conformance to design feature as per specification clause no. 3.0 & 4.0 - Yes / No	
5	Submitted of deviation sheet for each specification clause no - Yes / No	
6	Battery GA drawing submitted - Yes / No	
6.1	Battery selection / sizing calculation submitted - Yes / No	
7	Battery rating (C5) offered in Ahr	
7.1	Rating at temperature 27 deg C as per IS	
7.2	Rating at temperature 20 deg C as per IEC	
8	Battery race type offered -steel or FRP	
8.1	Number of steps in a tire	
8.2	Number of tires in a rack	
9	Battery bank dimensions in mm ( length x depth x height)	
10	Battery cell weight in kg	
11	Battery cell anode --- no. of plates & thickness in mm	
12	Battery cell cathode --- no. of plates & thickness in mm	
13	Battery cell nominal voltage	
13.1	Battery cell float charge voltage	
14	Battery cell maximum boost charge voltage	
15	Battery cell end cell voltage	
16	Total battery bank float charging voltage required in volts	
17	Total battery bank boost charging voltage required volts	
17.1	Total time required for boost charging from and cell voltage to rated voltage /capacity.	
18	Battery internal resistance ( in Ohms ) at fully charged condition	
19	Heat generated by battery at rated full load (in Kw)	
20	Electrolyte chemical name	
21	Electrolyte specific gravity at 27 deg C	
22	Recommended topping up frequency (in weeks or months)	
23	Amount of gas evolution in one full charge discharge cycle (in liter / Ahr)	
24	Type of separators used in battery cell	

**Volume – 2 Schedules & Annexure**

**Schedule B3**

25	Shelf life period ( to retain 90% of energy from full charge condition at 27 deg C)	
26	Total battery bank short circuit fault level ( in KA)	
27	Battery bank terminal bus bar with insulating shrouds - Yes /No	

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – B4**  
**BATTERY CHARGER with DCDB**

Sr. No.	Description	Data to be filled by manufacturer
1	Manufacturer equipment type	
2	Conformance to design standards as per specification Yes / No	
3	Conformance to design features as per specification Yes / No	
4	Submitted to deviation sheet for each specification clause no - Yes / No	
5	Panel dimension in mm ( length x depth x height )	
6	Panel weight in kg	
7	Panel enclosure protection offered	
8	Voltage regulation as per specification ( value to be specified)	
9	Boost charging DC current adjustment range (Value to be specified)	
10	Amount of Ripple in DC in % - output with battery - without battery	
11	Charger efficiency offered	
12	Max temperature rise above ambient	
13	Power factor at rated load	
14	Rectifier bridge as per specification	
15	Heat generated by the panel in Kw	
16	AC MCCB - Make , rating	
17	DC MCCB - Make , rating	
18	Rectifier transformer - Make , rating	
19	Semiconductor rectifier - Make , rating	
20	DC conductor - Make , rating	
21.1	DCDB integral part of charger or separate?	
21.2	MCB for DC distribution boards - Make, rating	
22	Conformance to metering & indication as per specification	
23	Conformance to make of component as per specification	
24	Conformance to mimic diagram, labels & finish as per specification	
25	Submission of component catalogue - Yes / No	
26	DC charger nominal output current - ( battery trickle charge + DC load)	
27	DC charger boost charge current	

**Volume – 2 Schedules & Annexure**

**Schedule B4**

28	DC battery	
29	DC battery duty cycle	
30	DC distribution board output DP MCB feeders required	
30.1	63 amp DP MCB	
30.2	40 amp DP MCB	
30.3	25 amp DP MCB	
30.4	16 amp DP MCB	
30.5	10 amp DP MCB	

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE –B5**  
**11kV AUTO-SWITCHED CAPACITOR BANK**

S.No.	Description	
1	Manufacturer equipment type/make	
2	Conformance to design standards as per	
	specification Yes/No	
	- Capacitor Unit	
	- Series Reactor	
	- LA	
	- Isolator	
	- NCT	
3	Conformance to capacitor design requirements as per specification clause no.3.0 to 7.0 - Yes/No	
4	Submission of deviation sheet for each specification clause no. -Yes/No	
5	APP type capacitors offered?	
6	Capacitor bank arrangement / scheme conforming to specification?	
7	Capacitor bank ( 3 phase system)	
7.1	Capacitor bank ( Rated capacitance at 50Hz)	
7.2	Capacitor bank rated voltage – 12Kv	
7.3	Capacitor bank KVAR at 11kV	
7.4	Capacitor bank KVAR at 12kV	
7.5	Capacitor bank line current at rated voltage, continuous operation	
7.6	Designed short circuit withstand capacity for 3sec	
7.7.1	Capacitor bank insulation level at 50Hz	

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**Schedule B5**

7.7.2	Capacitor bank impulse voltage withstand	
7.8	One spare single phase capacitor unit offered?	
<b>8</b>	<b>Capacitor single phase unit</b>	
8.1	Capacitor single unit capacitance at 50Hz	
8.2	Capacitor single unit rated operating voltage	
8.3	Capacitor KVAR ( at rated voltage )	
8.4	Capacitor single unit continuous operating rated current	
8.5	Designed short circuit withstand capacity of single capacitor unit for 3sec	
8.6	Capacitor unit temperature category ( required +5/ C)	
<b>9</b>	<b>Single capacitor unit construction</b>	
9.1	Enclosure sheet metal CRCA	
9.2	Enclosure sheet metal thickness in mm	
9.3	Hermetic sealing method (pressure welding/gas welding/sealant/ if any other pl. specify)	
9.4	Dimensions of a single capacitor unit	
	Height	
	Length	
	Width	
9.5	Weight of a single capacitor unit	
9.6	Single capacitor unit bushings	
	Type of insulator	
	Creepage distance	
	Clearance between two terminals	
9.7	No. of series group/unit	
9.8	No. of parallel elements/ series group	
9.9	No. of APP layers -double/triple	



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**Schedule B5**

9.10	Thickness of APP film	
9.11	Width of APP film	
9.12	Thickness of Al foil	
9.13	Width of Al foil	
9.14	Active width of Al foil	
9.15	Maximum voltage stress per APP layer	
9.16	Element connection method	
9.17	Discharge device	
10	Capacitor bank maximum permissible over voltage	
11	Capacitor power loss at rated voltage	
12	Capacitor tan delta ( Tangent of power loss angle) at maximum operating conditions	
13	Guaranteed temperature rise of capacitor above ambient temperature	
14.1	Type of discharge device – internal resistor	
14.2	Discharge device material	
14.3	Value of discharge device	
14.4	Discharge time required to attain residual voltage equal to 50 volts	
15	Capacitor bank overall dimensions	
	Height x Length x Width	
16	Capacitor bank total weight	
17	Capacitor bank clearances	
	i)Phase to Phase	
	ii)Phase to neutral	
	iii)Phase to earth	
18	Tinned copper Bus bar cross-section in sq. mm	

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**Schedule B5**

19	Tinned copper Bus bar continuous rating	
20	Bus bar short time withstand capacity in kA for 3sec	
21	Flexible tinned copper connector rating	
22.1	Bus bar support insulator make & type	
22.2	Bus bar support insulator voltage class	
23	Bus bar provided with insulating sleeve and phase barriers?	
<b>24</b>	<b>Neutral Current transformer</b>	
24.1	Neutral current transformer make	
24.2	Neutral current transformer outdoor type	
24.3	Cast resin type NCT offered?	
24.4	Neutral current transformer ratio	
24.5	Neutral current transformer accuracy class (0.5 & 5P10min)	
24.6	Neutral current transformer rating( 10 & 15VA)	
24.7	Neutral current transformer terminal box ingress protection (IP55min)	
24.8	<b>Residual Voltage Transformer</b>	
<b>25</b>	<b>Series Reactor</b>	
25.1	Series reactor make	
25.2	Continuous current rating of series reactor	
25.3	Series reactor kVAr rating per phase per star	
25.4	Series reactor rated voltage	
25.5	Type –dry air cooled	
25.6	Short time withstand current capacity for 3sec ( min 16 times capacitor rated current at 130% rated voltage )	
25.7	Series reactor single phase unit connected between single phase capacitor units and neural star pint	

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**Schedule B5**

25.8	Series reactor power frequency withstand voltage 28Kv MIN	
25.9	Series reactor lightening impulse withstand voltage 75kv min	
<b>26</b>	<b>Lightning Arrestor</b>	
26.1	Name of manufacturer	
26.2	Type – Gapless ZnO	
26.3	Rated voltage	
26.4	Nominal Discharge Current	
26.5	Class - III	
26.6	Insulation withstand voltage	
26.7	Crrepage distance	
<b>27</b>	<b>Vacuum Contactor / switch for Auto Switching</b>	
27.1	Rated Voltages	
27.2	Rated Continuous Current	
27.3	Rated Capacitor Switching Current	
27.4	Frequency	
27.5	Control supply	
27.6	Type	
27.8	Installation	
27.9	Mechanical Endurance	
27.10	Electrical Endurance	
27.11	Mechanical Indicator	
27.12	Trip lever	
27.13	Closing lever	
<b>28</b>	<b>Isolator</b>	

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**Schedule B5**

28.1	Name of manufacturer	
28.2	Isolator ratings	
28.3	Type of operation	
28.4	Type	
28.5	Operating mechanism	
28.6	Voltage rating	
28.7	Rated current	
28.8	No.of poles	
28.9	Rated short time current	
28.10	Type of mounting	
28.11	Construction	
28.12	Earth switch provided	
28.13	Auxiliary contacts provided	
28.14	Electrical interlocks	
28.15	Mechanical interlocks	
28.16	Creepage distance	
28.17	Insulation level - Power frequency withstand Voltage - Impulse withstand voltage	
28.18		
	Terminal arrangement a) Incoming suitable for b) Outgoing suitable for	
28.19	Overload capacity	
28.20	Control voltage	
29	Name plate and labels as per specification?	

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**Schedule B5**

30	Painting of capacitor and mesh enclosure	
30.1	Shade RAL 7032	
30.2	Material – Pure polyester grade A	
30.3	Minimum thickness ( 80 microns )	
31	Power cable terminal suitable for 3CX300Sqmm XLPE HT	
32	Space provided for future capacity	

	Bidders Name	:	_____
	Signature	:	_____
	Name	:	_____
	Designation	:	_____
Seal of Company	Date	:	_____

**SCHEDULE – B6**  
**LT POWER CABLES**

For each size / rating separate GTP need to be furnished.			
S.No.	Description	Buyer's requirement	Seller's Data
1	Make	.....	
2	Type (AS PER IS)	A2XFY (Multicore)	
3	Voltage Grade (KV)	1.1	
4	Maximum conductor temperature		
A	Continuous ( ° C)	90 °C	
B	Short time ( ° C)	250 °C	
5	Conductor		
A	Size (mm <sup>2</sup> )	4CX300,4CX50, 4CX25, 4CX10 & 2CX10 Sqmm	
B	No. of wire in each conductors Nos.	As per Manufacturer standard	
C	Dia of wires in each conductors before compaction (mm)	As per Manufacturer standard	
D	Shape of conductor	As per specification	
E	Diameter over conductor (mm)	.....	
F	Maximum conductor resistance at 20 <sup>0</sup> C (ohm / km)	As per table 2 of IS -7098 Part -1	
6	Insulation		
A	Nominal thickness (mm)	As per table 3 of IS -7098 Part -1	
B	Minimum thickness (mm)	.....	
C	Diameter over insulation (mm) Approx	.....	
7	Inner Sheath		
A	Minimum thickness	As per table 5 of IS -7098 Part -1	
B	Approx dia over sheath (mm) Approx	.....	
8	Galvanized steel Armour	As per table 6 of IS -7098 Part -1	
A	Number of strips	As per manufacturer Std.	
B	Size (Thickness X width ) in mm	0.8 x 4	
C	Dia of wire for 2CX10sqmm	1.4mm Min	
D	Dia over Armour -Approx	.....	
9	Outer Sheath	As per table 8 of IS -7098 Part -1	
A	Thickness (Minimum)		
B	Colour	Yellow	
C	Weather proof paint (applicable for 2c x 10 sqmm and 4c x 10 sqmm only)	.....	
10	Approx. overall dia (mm)	.....	
11	End Cap	Required	
12	Continuous current rating for standard I.S. condition laid Direct		

**Volume – 2 Schedules & Annexure**

**Schedule B6**

	a. In ground 30 °C Amps	.....	
	a. In duct 30 °C Amps	.....	
	a. In air 40 °C Amps	.....	
13	Short circuit current for 1 sec of conductor (KAmp)	.....	
14	Electrical Parameters at Maximum operating temperature		
A	Resistance (Ohm / Km) (AC Resistance)	.....	
B	Resistance AT 50 C/s (Ohm / Km)	.....	
C	Impedance (Ohm / Km)	.....	
D	Capacitance (Micro farad /Km)	.....	
15	Recommended minimum bending radius	..... X O/D	
16	De-rating factor for following Ambient Temperature in	Ground /Air	
	a. At 30 °C		
	a. At 35 °C		
	a. At 40 °C		
	a. At 45 °C		
	a. At 50 °C		
17	Group factor for following Nos. of cables laid	Touching Trefoil	
A	3 Nos.		
B	4 Nos.		
C	5 Nos.		
D	6 Nos.		
18	Process of cross linking of polyethylene	Dry cure	

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B7**  
**CONTROL CABLES**

Sr.	Description	Buyers's requirement	Seller's Data
1.0	Make		
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> )	10CX2.5, 6CX2.5Sqmm	
B	No. of wire in each conductor Nos.	As per Manufacturer standard	
C	Dia. of wires in each conductors before compaction (mm)	As per Manufacturer standard	
D	Shape of conductor	As per the specification	
E	Maximum conductor resistance at 20°C (Ω/Km.)	As per Table 2 of IS 8130	
F	Number of conductor core		
6.0	Insulation		
A	Nominal thickness (mm)	As per CI & table 2 of IS-1554 Part-1	
B	Minimum thickness (mm)		
C	Diameter over insulation (mm) approx.		
7.0	Inner Sheath		
A	Minimum thickness	As per Table 4 of IS-1554 Part-1	
B	Approx. dia Over sheath (mm) approx.		
8.0	Galvanized steel armour	a) As per CI 13.2 of IS 1554 Part-1: Galvanized steel round wire armour. b) Minimum area of coverage of armouring shall be 90%.	
A	Number of wire/strip	As per Manufacturer standard	
B	Size (Dia/thickness x width) in mm		
C	Dia over Armour -Approx		
9.0	Outer Sheath		
A	Thickness (Minimum)	As per Table 7 of IS-1554 Part-1	
B	Colour	Black	
10.0	Approx overall dia (mm)		
11.0	End Cap	Required	
12.0	Drums provide with MS Spindle plate & nut bolts arrangement	Required	



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**Schedule B7**

13.0	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		
14.0	Recommended minimum bending radius	12 x O/D	
15	Minimum Armour Coverage	90% minimum	
16	Lay Ratios		
16.1	Main Conductor		
16.2	Armour		

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – B8**  
**ILLUMINATION SYSTEM**

<b>1</b>	<b>General</b>			
+1.01	Make			
*1.02	Applicable Standards			
*1.03	Degree of protection			
<b>2</b>	<b>Lighting Panel /Feeder Pillarm Box (LP/ELP/DLP/FPB/EPB/LDB/ELDB/ Construction Features)</b>			
2.01	Make			
2.02	Rated Value (V)			
*2.03	Busbar continuous current rating (A)			
*2.04	Busbar material and cross section	1	2	3
<b>3</b>	<b>Minimum current breakers :</b>			
+3.01	Service			
3.02	Make			
+3.03	Type			
*3.04	No. of poles			
*3.05	Rated continuous current (A)			
*3.06	Short time current rating (Ka)			
*3.07	Related Voltage (V)			
*3.08	Breaking Current (Ka)			
<b>4</b>	<b>Load Breaking Switches</b>			
4.01	Service			
+4.02	Make			
+4.03	Type			
*4.04	No. of poles			
*4.05	Related Voltage (V)			
*4.06	Rated continuous current (A)			
*4.07	Rated making current (Ka peak)			
*4.08	Rated breaking current (Ka)			
*4.09	Rated short time one (1) second current (Ka)			
*4.10	Rated dynamic current (kApeak)			
<b>5</b>	<b>Fuses</b>			
5.01	Service			
+5.02	Make			
*5.03	Type			
*5.04	Standard applicable			
*5.05	Related Voltage (V)			
*5.06	Rated current (A)			
*5.07	Fusing factor			

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**Schedule B8**

*5.08	Category of duty			
*5.09	Rupturing capacity (prospective current) (Ka)			
<b>6</b>	<b>Earth Leakage current Breaker</b>			
+6.01	Make			
+6.02	Type			
*6.03	No. of poles			
*6.04	Rated continuous current (A)			
6.05	Short time current rating (Ka)			
6.06	Rated Tripping current			
<b>7</b>	<b>Lighting Fixtures</b>	Type A	B	C
+7.01	Manufacturer			
+7.02	Type			
7.03	Description of different types			
*7.04	Type and wattage of lamp			
*7.05	Rated life of the lamp			
*7.06	Applicable standards			
	Note:- In case luminaries other than the ones specified in specification are offered, all the deviations shall be listed out otherwise these shall be considered as being fully in line with luminaries specified.			
<b>8</b>	<b>Receptacles with Switches</b>	1	2	3
+8.01	Make			
+8.02	Type			
+8.03	Related Voltage (V)			
*8.04	Rated current (A)			
8.05	Technical brochures (Attach brochures and state brochure Nos.)			
<b>9</b>	<b>Cables / Wire</b>	1	2	3
9.01	Service			
+9.02	Make			
+9.03	Type			
*9.04	Voltage Grade (V)			
*9.05	Conductor Material			
*9.06	Size of conductors (mm <sup>2</sup> )			
*9.07	Current rating of conductors (A)			
9.08	Applicable Standards			
<b>10</b>	<b>Conduits and Accessories</b>			
10.01	Make			
10.02	Type			
10.03	Material			
10.04	Applicable Standards			
<b>11</b>	<b>Lamp and Luminaries</b>	Incandescent Lamps	Fluorescent Tubes	HPSV Lamps
11.01	Make			

**Volume – 2 Schedules & Annexure**

**Schedule B8**

11.02	Type			
*11.03	Lumen output throughout life (Lumen)			
*11.04	Derating factor due to temperature			
*11.05	Derating factor due to aging			
<b>12</b>	<b>Lighting Poles / Towers</b>			
12.01	Manufacturer			
12.02	Applicable Standards			
12.03	Material and Painting			
12.04	Height			

Notes :

1. Single asterisk (\*) marked particulars are guaranteed.
2. Other particulars are bonafide and may vary slightly upon completion of detailed design.
3. Particulars against items marked \* and + shall be furnished with the Bid.

	Bidders Name	:	_____
	Signature	:	_____
	Name	:	_____
	Designation	:	_____
Seal of Company	Date	:	_____

**SCHEDULE – B9**  
**AC DISTRIBUTION BOARDS**

S.No	Description	Buyers Requirement	Sellers Data
<b>1</b>	<b>Panel Construction</b>		
1.1	Enclosure Type	Free standing, indoor, Fully compartmentalized, Metal clad, Vermin Proof	
1.2	Enclosure degree of protection	IP 5X	
1.3	Enclosure Material	CRCA steel	
1.4	Load bearing members	Minimum 2.5 mm thick	
1.5	Doors and covers	Minimum 2.0 mm thick	
1.6	Gland Plate (detachable type)	3.0mm MS detachable type or Aluminum 5.0mm for single core cables	
1.7	Separate compartment for	Bus bar, circuit breaker, incoming cable, outgoing cable PT, LV instruments.	
1.8	Breaker compartment door	Separate with lockable handle	
1.9	Fixing arrangement i. Doors ii. Covers iii. Gasket	Concealed hinged Bolted with SS bolts Neoprene	
1.10	Panel Base Frame	Steel base frame as per manufacturer's standard.	
1.11	Handle	Removable bolted covers for cable chamber and busbar chamber shall be provided with "C" type handles	
1.12	Space Heater	Required	
1.13	Panel extension possibility	Required	
<b>2</b>	<b>MCCB</b>		
2.1	Mounting	Flush Mounted	
2.2	Rated Operational Voltage(V)	415 volt	
2.3	Ultimate breaking Capacity		
2.3.1	630A MCCB	As per requirement	
2.3.2	100A MCCB	As per requirement	
2.4	Rated Service breaking capacity at rated voltage Ics	Ics =100% Icu	
2.5	Rotary handle	Required	
2.6	Interlocking arrangement	Between Incomer MCCBs	
2.7	Trip time	As per requirement	
2.8	Test Certificates	Should have test certificates for breaking capacities from independent test authorities	

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**Schedule B9**

		CPRI / ERDA or equivalent	
<b>3</b>	<b>MCB</b>		
3.1	Rated Operational Voltage(V)	415 VAC 50 Hz	
3.2	Protection relay/Release	Magnetic thermal release for over current and short circuit protection	
3.3	Breaking capacity	Shall not be less than 10 KA at 415 VAC	
3.4	Mounting	Din mounted	
3.5	MCB classification	As required	
3.6	ISI Marked	The complete range shall be ISI marked	

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – B10**

**HIGH MAST**

Sl. No.	Particulars	Data by purchaser			Data by seller
1	Name and address of manufacturer				
2	Overall height of high mast	12 mtrs	16 mtrs	20 mtrs	
2.1	Make				
2.2	Material of construction of shaft	Grade S355 J O as per BSEN 10025 or equivalent			
2.2	Cross section of mast	20 sided, regular continuously tapered polygonal			
2.3	Number of sections	One	Two	Two	
2.3	Minimum thickness of shaft (mm)	4 mm	Bottom section: 5 mm Top section: 4mm	Bottom section: 5 mm Top section: 4mm	
2.4	Length of individual section (mm)	12000 mm	10900mm / 5850mm	10375mm / 10375mm	
2.5	Minimum Base and top diameter	340mm (A/F) and 150 mm (A/F)	450mm (A/F) and 150 mm (A/F)	500mm (A/F) and 150 mm (A/F)	
2.6	Type of joints	No site joints, mast should be delivered in a single section	Telescopic slip joint, stress fitted	Telescopic slip joint, stress fitted	
2.7	Length of overlap	N/A	750mm	750mm	
2.8	Metal protection treatment of fabricated mast section	Hot dip galvanization through single dipping process			
2.9	Thickness of galvanizations	Minimum 85 microns as per IS:2629			
2.10	Size of opening	Approx. 250 X 1200 mm			

**Volume – 2 Schedules & Annexure**

**Schedule B10**

Sl. No.	Particulars	Data by purchaser			Data by seller
	door at base				
2.11	Type of locking arrangement and door construction	Anti vandal type			
2.12	Details of struck board inside	Insulated base board			
2.13	Size , material and thickness of cable termination box				
2.14	Minimum size of base plate diameter	540 mm (min.)	650 mm (min.)	680 mm (min.)	
2.15	Minimum size of base plate thickness	25 mm thick			
2.16	Minimum size of anchor plate thickness	8 mm			
2.17	Details of template	Same as anchor plate but 2 mm thick			
<b>3</b>	<b>Dynamic loading as prevailing at site</b>				
3.1	maximum wind pressure (basic wind speed)	47m/s as per IS:875, p-3			
3.2	Maximum gust speed time	3 seconds			
3.3	Height above ground level at which wind speed is consider	10 mtrs			
3.4	Factor of safety for wind load	1.25			
3.5	Factor of safety for other load	1.15			
3.6	Application standard for mast design	Technical report #7:2000 by ILE, UK			
<b>4</b>	<b>Foundation details</b>				
4.1	Type of foundation	Open raft shallow footing or pile as applicable			



**Volume – 2 Schedules & Annexure**

**Schedule B10**

Sl. No.	Particulars	Data by purchaser			Data by seller
4.2	Size of foundation	as per design conforming to IS:456			
4.3	Design safety factor	2			
4.4	Considered wind speed	180 m /s			
4.5	Depth of foundation	As per requirement of design			
4.6	Average soil bearing capacity	As per site condition			
4.7	Numbers of foundation bolts	6 nos	8 nos		
4.8	PCD of foundation bolts	440 mm (min.)	550 mm (min.)	600 mm (min.)	
4.9	Type of foundation bolt	Tor steel			
4.10	Bolt diameter / length	25mm dia / 750 mm	32mm dia / 1325 mm	40mm dia / 1375 mm	
<b>5</b>	<b>Lantern Carriage</b>				
5.1	Diameter of Carriage Ring	Suitable to carry up to 4 nos. floodlights	1200 mm	1200 mm	
5.2	Construction	MS Channels / Tube, Hot dip galvanized	Channels 75X40X4mm thick	Channels 75X40X4mm thick	
5.3	Number of joints	As per manufacturer's standard design (2 segments as per CI no.4.5)	3 segments (2 segments as per CI no.4.5)	3 segments (2 segments as per CI no.4.5)	
5.4	Buffer arrangement between carriage and mast	Rubber padded guide ring provided			
5.5	Load carrying capacity	500 kg	750 kg	750 kg	
5.6	Total weight of assembly with	as per design			

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**Schedule B10**

Sl. No.	Particulars	Data by purchaser		Data by seller
	fitting			
<b>6</b>	<b>Winch</b>			
6.1	Make of winch			
6.2	Number of drums/ winch	Double drum		
6.5	Gear Ratio			
6.3	Capacity	SWL 500 kg	SWL 750 kg	
6.4	Method of operation	Manual / Inbuilt power tool		
6.6	Operating speed			
6.7	Lubricant Arrangement	Permanent oil bath		
6.8	Type of lubricant			
6.9	Material of construction of gear	Phosphorus Bronze / EN 19		
6.10	Tested load per drum	500 kg	750 kg	
6.11	SWL of winch at 410 rpm	500 kg SWL	750 kg SWL	
<b>7</b>	<b>Wire rope</b>			
7.1	Make			
7.2	Grade	AISI 316		
7.3	Number of ropes	3 nos / 5mm (three wire rope)	3 nos / 6 mm (three wire rope)	
7.4	Construction	7./19		
7.5	Diameter of Wire rope	5mm	6mm	
7.6	Factor of safety	Not less than 5	Not less than 6	
7.7	Breaking capacity	Minimum 2350Kgs. X 2		
<b>8</b>	<b>Cable</b>			
8.1	Type	EPR coated PCP sheathed		
8.2	Material	Multicore copper conductor		
8.3	Make	Finolex, torrent, Polycab, KEI, Havells		
8.4	Current carrying capacity	As per IS 9968 (Part - 1), 1998		

**Volume – 2 Schedules & Annexure****Schedule B10**

Sl. No.	Particulars	Data by purchaser			Data by seller
8.5	conductor size	5CX2.5 sqmm.			
<b>9</b>	<b>Torque limiter</b>				
9.1	Lifting capacity	Upto 500 kg	Upto 750 kg		
9.2	Adjustable / non adjustable	Adjustable			
<b>10</b>	<b>Lantern and Fixture</b>				
10.1	Type Of Lamp	LED			
10.1.1	Wattage	250W			
10.1.2	Make				
10.1.3	Model Number				
10.2	Housing	Single piece gravity die-cast			
10.2.1	Material	Aluminium alloy: LM6			
10.2.2	Ingress protection				
10.2.3	For optical compartment	IP:65/IP:66			
10.2.4	For control gear compartment	IP:54 or better			
10.2.5	Dimensions of lantern	As per design standard			
10.2.6	Weight of lantern with control gear	As per design standard			
10.3	Lamp Cover	Perspex/Toughened glass			
10.3.1	Toughened glass				
10.3.2	Class of glass	AA/SSQ			
10.3.3	Nominal thickness	5mm			
10.3.4	Perspex thickness	2.5mm+/-0.4 mm			
10.4	Material of gasket	Silicon Rubber/ Neoprene			
10.5	Lamp holder	Screw type/three pin type			
10.5.1	Material	Porcelain			
10.6	Ballast	Conventional/Open type/ VI/VPI			
10.6.1	Ballast voltage	240V AC			
10.6.2	Minimum open circuit voltage	198V			
10.6.3	Frequency	50 Hz			
10.6.4	Current output(A), at rated voltage				
10.6.5	Voltage to current ratio ( ) +/-0.5%				
10.6.6	Watt loss ( W )	To be specified			

**Volume – 2 Schedules & Annexure**

**Schedule B10**

Sl. No.	Particulars	Data by purchaser			Data by seller
10.7	Power factor of lantern	More than 0.95 lag			
10.7.1	Value of capacitor	To be specified			
10.8	Igniter	Three wire			
10.9	Reflector	Anodised/POT			
10.9.1	Angle of tilt of lamp	To be specified			
10.9.2	Downward light output ratio	More than 70%			
10.9.3	Angle of throw	As per clause 5.12.5			
10.9.4	Angle of spread	As per clause 5.12.6			
10.9.5	Luminous intensity in C = 0° plane at $\gamma = 90^\circ$	Less than 10 Cd/klm			
10.9.6	Luminous intensity in C = 0° plane at $\gamma = 80^\circ$	Less than 30 Cd/klm			
10.10	Make of fixture	Bajaj, GE, Philips and CGL			
10.10.1	Nos of fixture provided with high mast	4	5	6	
10.10.2	Type of fixture	Weather proof			
<b>11</b>	<b>Others</b>				
11.1	Make of 24 hour Differential Timer Switch	Legrand/ GE/ Schnider/ L&T			
11.2	Make of 32A TPN MCB	GE/ Hager/ Legrand/ Schnider			
11.3	Make of 32A Contactor	L&T/ Schnider/ GE			
11.4	Earth pit	Two numbers of treated earth pit with each mast			
12	GTP and Drawing Submitted	Yes/No			
13	Type Tests Submitted	Yes/ No			

**Volume – 2 Schedules & Annexure**

**Schedule B10**

Sl. No.	Particulars	Data by purchaser	Data by seller
14	Technical Brochure of luminaries submitted	YES / NO	
15	Operation and maintenance manual submitted	YES / NO	

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – B11**  
**GROUNDING & LIGHTNING PROTECTION SYSTEM**

S.No.	Description	Unit	Data by vendor
<b>1</b>	<b>Earth mat</b>		
a	Material		
b	Size of conductor		
c	Fault withstand current & duration		
<b>2</b>	<b>Equipment Earthing</b>		
a	Material		
b	Size of conductor		
<b>3</b>	<b>Earth Electrode</b>		
a	Material		
b	Size		
c	Length		
<b>4</b>	<b>Lightning Protection System</b>		
a	Material and size of horizontal air termination		
b	Material and size of vertical air termination		
c	Material and size of down conductor		
d	Size of test link		
e	Material of enclosure for test link		
f	Material and size of earth electrode		

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B12**  
**CABLE ACCESSORIES**

<b>1</b>	<b>Cable Accessories</b>	
1.01	Makes	
1.02	Termination kits	
1.03	Straight through joint kits	
1.04	Cable glands	
1.05	Cable lugs	
1.06	Termination blocks	
1.07	Types	
1.08	Termination kits	
1.09	Straight through joints	
1.1	Cable glands	
1.11	Cable lugs	
1.12	Terminal blocks	

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B13**  
**66 KV OUT DOOR CURRENT TRANSFORMER**

**A) 66 kV, 400-200/1/1/1/1A**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	66 kV							
5	Highest System Voltage	72.5 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	400-200 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.5 0.2s for Line Feeder	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			40 (RCT+8)	40 (RCT+8)				
10.8	Magnetizing current at $V_k/2$ (project specific)			30 mA	30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	31.5 kA							



**Volume – 2 Schedules & Annexure**

**Schedule B13**

12	Rated dynamic current of primary		
13	Rated continuous thermal current		
14	Temp rise at an ambient of 50 deg C		
14.1	Winding		
14.2	Oil at the top		
14.3	Exposed current carrying parts		
15	One minute power frequency dry withstand voltage (KV rms)	140 kV rms	
16	One minute power frequency wet withstand voltage (KV rms)	140 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	325 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

**Volume – 2 Schedules & Annexure**

**Schedule B13**

**B) 66 kV 1600-800/1/1/1/1A**

	Description	Data By Purchaser				Data By Supplier			
1	Name of Manufacturer								
2	Address and contact details								
3	Type								
4	Rated Nominal Voltage	66 kV							
5	Highest System Voltage	72.5 kV							
6	Rated Frequency	50 Hz							
7	Rated Primary Current	1600-800 A							
8	Rated Secondary current	1A							
9	Number of cores								
10.0		Core-1	Core-2	Core-3	Core-4				
10.1	Secondary Current	1A	1A	1A	1A				
10.2	Purpose /Application	Metering	Protection (O/C & E/F)	Protection (Bus Bar)	Protection (Spare)				
10.3	Rated output (project specific)	30 VA	30 VA						
10.4	Class of accuracy	0.5 0.2s for Line Feeder	5P	PS	PS				
10.5	Instrument security factor	≤ 5							
10.6	Accuracy limit factor		20						
10.7	Knee point voltage & corresponding exciting current (project specific)			40 (RCT+8)	40 (RCT+8)				
10.8	Magnetizing current at Vk/2 (project specific)			30 mA	30 mA				
10.9	Resistance of the secondary winding at 75 deg C								
10.10	Secondary limiting voltage								
11	Short time thermal rating of primary								
11.1	One Seconds								
11.2	Three seconds	31.5 kA							
12	Rated dynamic current of primary								
	Description	Data By Purchaser				Data By Supplier			
13	Rated continuous thermal current								

**Volume – 2 Schedules & Annexure**

**Schedule B13**

14	Temp rise at an ambient of 50 deg C		
14.1	Winding		
14.2	Oil at the top		
14.3	Exposed current carrying parts		
15	One minute power frequency dry withstand voltage (KV rms)	140 kV rms	
16	One minute power frequency wet withstand voltage (KV rms)	140 kV rms	
17	1.2/50 microsecond impulse withstand test voltage KV peak	325 kVp	
18	Minimum creepage distance in mm	31 mm/kV	
19	Protective creepage distance in mm		
20	Magnetization curve of CT core		
21	Variations in ratio and phase angle error due to variation in		
21.1	Voltage by 1 Volt		
21.2	Frequency by 1Hz		
22	Current density in primary winding		
23	Weight of oil		
24	Total weight		
25	Mounting details		
26	Overall dimensions		
27	Terminal Connector		

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B14**

**66 KV OUT DOOR POTENTIAL TRANSFORMER & CVT**

	Description	Data By Purchaser	Data By Supplier
1.0	Location of Equipment	Project specific to be filled up	
2.0	Name of Manufacturer		
3.0	Address & Contact details		
4.0	Type	Single phase, outdoor, dead tank type, oil immersed, self-cooled type.	
5.0	Manufacturer Model No		
6.0	Reference design ambient temperature	50 Deg C	
7.0	Reference Standard	IS: 3156 (Part1 to 4)	
8.0	Nominal system voltage	66KV	
9.0	Highest system voltage	72.5KV	
10.0	Basic Insulation level	325KVp	
11.0	Power frequency voltage	140KV	
12.0	Type of cooling	ONAN	
13.0	Rated frequency (Hz)	50 Hz	
14.0	Insulation Class	A	
15.0	Rated Primary voltage	66KV / $\sqrt{3}$	
16.0	Rated secondary voltage	110V / $\sqrt{3}$	
17.0	Number of secondary cores	Two	
18.0	<b>CORE Specifications</b>		
18.1	Core - 1		
18.2	Purpose	Metering	
18.3	Rated Output	50 VA	
18.4	Class of accuracy	0.2S	
18.5	Ratio error	As per IS	
18.6	Phase angle error	As per IS	
19.0	Core - 2		
19.1	Purpose	Protection	
19.2	Rated Output	50 VA	
19.3	Class of accuracy	3P	
19.4	Ratio error	As per IS	
19.5	Phase angle error	As per IS	
20.0	Rated over voltage factor		
20.1	- Continuous	1.2 times	
20.2	- 30 Seconds	1.5 times	
21.0	Temperature rise above an ambient of 50Deg C at 1.2 times voltage factor for 30 seconds rating		
21.1	- For Winding	50 Deg C	

**Volume – 2 Schedules & Annexure**

**Schedule B14**

21.2	- For Oil	40 Deg C	
22.0	Temperature rise above an ambient of 50Deg C at 1.5 times voltage factor for 30 seconds rating		
22.1	- For Winding	50 Deg C	
22.2	- For Oil	40 Deg C	
23.0	One minute power frequency dry withstand voltage for 66 kV PT (KV rms)		
24.0	One minute power frequency wet withstand voltage for 66 kV PT (KV rms)		
25.0	1.2/50 microsecond impulse withstand test voltage for 66 KV PT (KV rms)	325 KVp	
26.0	One minute Power frequency withstand voltage on secondary winding	3KV	
27.0	Minimum creepage distance in mm for 66KV PT	2250 mm	
28.0	Protective creepage distance in mm for 66KV PT	1125 mm	
29.0	Partial discharge test, whether will be carried out Yes / No		
30.0	Weight of core		
31.0	Weight of oil		
32.0	Total weight		
33.0	Mounting details		
34.0	Overall dimensions		

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

Seal of Company

**SCHEDULE – B15**  
**66 KV OUT DOOR CIRCUIT BREAKER**

Sl. No.	Item 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	SF6	
5.0	Installation	Outdoor	
6.0	No. of phase & no. of pole	3 (Three), 3 (Three)	
7.0	Rated voltage (kV)	66KV	
8.0	Highest System voltage (kV)	72.5 KV	
9.0	System neutral	Solidly earthed	
10.0	Rated insulation level	325KVp	
11.0	Frequency (Hz)	50 Hz	
12.0	Class		
13.0	Normal current rating (amps)		
13.1	Under standard conditions	2000 A	
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 sec b) For 3 sec	31.5 kA for 3 Sec	
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		

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**Schedule B15**

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)		
21.0	Break time (Milli-seconds)		
22.0	Closing time (Milli-seconds)	60ms (max)	
23.0	Minimum reclosing 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 reclosing (Milli-seconds)		
24.2	Limit of adjustment of dead time for 3- phase reclosing		
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		
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: c) On supply side d) On line side		

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**Schedule B15**

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 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		
34.1	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)	140kV (rms)	
35.2	Between terminals with breaker contact open (KV rms)	140kV (rms)	
36.0	Wet 1-minute power frequency test withstand voltage:		
36.1	Between line terminal and grounded parts (KV rms)	140kV (rms)	
36.2	Between terminals with breaker contact open (KV rms)	140kV (rms)	
36.3	Between poles		
37.0	1.2/50 microsecond wave impulse withstand test voltage for complete circuit breaker:		
37.1	Between line terminal and ground (KV peak)	325kVp	
37.2	Between terminals with breaker contact open (KV rms)	325kVp	
37.3	Between poles		
38.0	Minimum clearance in air		
38.1	Between phases (mm)	630mm (min)	
38.2	Live parts and earth (mm)	630mm (min)	



**Volume – 2 Schedules & Annexure**

**Schedule B15**

38.3	Live parts to ground level (mm)	4000mm (min)	
39.0	Number of operation possible without maintenance		
39.1	At full rated interrupting capacity		
39.2	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	140kV rms	
40.7	Wet-1 minute power frequency flashover voltage	140kV rms	
40.8	1.2/50 microsecond impulse flashover voltage	325kVp	
40.9	Creepage distance to ground (mm) c) Total d) 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 contact		
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/m2)		
47.0	Type of arcing contacts		
48.0	Contact pressure on main contact (kg/m2)		
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		

**Volume – 2 Schedules & Annexure**

**Schedule B15**

51.2	Which are open when breaker 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	
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	For SF6 gas circuit breaker		
65.1	Rated pressure of SF6 Gas in the gas cylinder (kg/sq cm)		
65.2	Quantity of SF6 gas required per single pole unit (kg)		
65.3	Quantity of SF6 gas required cylinder (kg)		
65.4	Weight of empty cylinder (kg)		
65.5	Quantity of absorbent required per pole(kg)		

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**Schedule B15**

65.6	Recommended interval for renewal of absorbent in case of outdoor circuit breakers operating in tropical conditions.		
65.7	Chemical composition of the absorbent		
65.8	Quantity of absorbent covered in the scope of supply. (including spare qty.) (kg)		
65.9	Limit of gas pressure for proper operation of circuit breaker		
65.10	Pressure and temperature at which temperature at which the temperature compensated gas pressure switch will: a) Give alarm b) Cut off		
65.11	Name of SF6 supplier and country of origin		
65.12	Quantity of SF6 gas supplied for: a) Actual use in breaker (kg) b) As spare (kg)		
65.13	Chemical composition of gas: a) Qty of air by weight (ppm) b) Qty of H2O by weight (ppm) c) Qty of CF4 by weight (ppm)		
66.0	Operating Mechanism		
66.1	Type of operating mechanism offered		
66.2	Manufacturer's type designation		
66.3	Material of control cabinet enclosure		
66.4	Thickness of sheet metal enclosure	3.0mm for bottom and 2.5mm elsewhere	
66.5	Painting & colour shade	Polyurthane paint, 692 of IS-5	
66.6	Enclosure protection	IP 55	
66.7	Pad locking facility provided (yes/No)		
66.8	Wiring a) Control wire size b) Insulation c) Colour	1.5 Sqmm  650V  Grey for control, Black for AC and Green for earth.	

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**Schedule B15**

66.9	Normal power consumption at rated voltage (Watt)		
66.10	Normal power spring charging motor		
66.11	Number of close/open operation possible after failure of AC supply to motor		
66.12	Time required to charge the closing spring		
66.13	Whether indication of spring charged condition provided in central control cabinet (Yes/No)		
66.14	Dimension of the control cabinets		
66.15	Weight of control cabinet		
67.0	Details of safety interlock provided		
68.0	Whether supporting structure for circuit breaker provided (Yes/No)		
68.1	Thickness of galvanizing (mm)		
68.2	Size of foundation bolts		
69.0	Material of nuts & bolts	Stainless steel	
70.0	Weight of 3-phase breaker complete with operating mechanism, insulating support frame work, etc.		
71.0	Impact loading for foundation design to include load plus impact value on operating at maximum interrupting ratings in terms of equivalent of static load.		
72.0	Weight of heaviest package		

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B16**  
**66 KV OUT DOOR LIGHTNING ARRESTER**

Sr. No.	Description	Data By Purchaser	Data by Supplier
1	Name of manufacturer		
2	Type	Gapless, ZnO type, single pole, heavy duty, station class, pedestal mounted	
3	Model		
4	No. of units.		
5	Installation	Outdoor	
6	Application	Protection of Transformers, circuit breakers, lines and other outdoor S/S equipment.	
7	LA connection to system	Phase to earth	
8	Type of Conductor	ACSR Zebra / Goat	
9	Construction	Single Phase	
10	Rated voltage of arrester (KVrms)	60 KV	
11	Nominal discharge current (Amps) (8x20 micro sec. wave) peak value	10KA	
12	System Particulars		
i)	Highest System Voltage	72.5 KV	
ii)	Frequency	50HZ $\pm$ 5%	
iii)	System neutral	Solidly earthed	
iv)	Max. value of temporary over voltage & its max. duration		
	- Insulation level of equipment to be protected	325 KVp	
	- System short circuit level	31.5KA for 3 seconds.	
13	Maximum continuous operating voltage (MCOV)	52KV	
14	Impulse withstand current	100KAp	
15	Long Duration discharge class	3	
16	Minimum single impulse energy capability		
17	Maximum residual voltage at switching impulse current of 1KA <sub>p</sub> (30/60 micro sec. wave)	136 KVp	

**Volume – 2 Schedules & Annexure**

**Schedule B16**

Sr. No.	Description	Data By Purchaser	Data by Supplier
18	Max. residual voltage (1x20 micro sec. wave)		
i)	At 05 KAp		
ii)	At 10 KAp		
iii)	At 20 KAp		
19	Minimum creepage distance	31 mm/KV	
20	Pressure relief class	40KA	
21	Reference current (mA)		
22	Leakage current at COV (mA)		
	Resistive		
	Capacitive		
23	Dry and wet power frequency withstand voltage of arrester insulation (KVrms)		
24	Virtual steepness for front of wave for above (KV/micro sec.)		
25	Ratio of system voltage withstand level to protection level of surge arrester		
26	High current impulse withstand 4/10 micro second peak value (KV)		
27	Long duration current Impulse		
i)	Current peak.		
ii)	Virtual duration.		
28	Temporary Over Voltage Capacity (KVp)		
i)	At 0.1 Sec.		
ii)	At 1.0 Sec.		
iii)	At 10.0 Sec.		
iv)	At 100.0 Sec.		
29	Weight of complete unit (Kg)		
30	Height of complete unit from base to the line side (mm)		
31	Minimum recommended spacing between arresters Centro to Centro (mm)		
32	Clearance required from ground equipment at various heights of arresters unit (mm)		

**Volume – 2 Schedules & Annexure****Schedule B16**

Sr. No.	Description	Data By Purchaser	Data by Supplier
33	Earthing arrangement provided for earthing side of arresters.		
34	Mounting flanges dimensional details.		
35	Type and range of milli-ampere meter.		
36	Type and specifications of the surge connectors.		
37	Surge counter min. current for recording a lightning stroke	200 Amp	
38	Surge counter max. disch. Current withstand	100KA peak for 4/10 wave shape.	
39	Range of continuous leakage current at rated voltage with variation due to change in temperature & frequency		
40	Size and length of flexible Cu cable for connection between LA & surge counter		
41	Voltage time curve for thermal stability of LA after a stroke	To be provided	
42	Paint shade of surge counter housing	Polyurethane, 692 of IS-5	

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B17**

**66 KV OUT DOOR DISCONNECTING SWITCH**

Sr. No.	Description	Data By Purchaser	Data by Supplier
1	Name of manufacturer		
2	Type	Motor operated, central rotating double break with turn & twist mechanism.	
3	Model		
4	No. of units.		
5	Installation	Outdoor horizontal	
6	System Particulars		
i)	Highest System Voltage	72.5 kV	
ii)	Rated frequency	50 Hz $\pm$ 5%	
iii)	System Neutral	Solidly Earthed	
7	Rated Insulation Data		
7.1	1.2/50 $\mu$ s lighting impulse withstand voltage (Positive and negative polarity)		
i)	To earth	325 kV	
ii)	Across the isolating distance	375 kV	
7.2	Rated One minute power frequency withstand voltage		
i)	To earth	140 kV	
ii)	Across the isolating distance	160 kV	
8	Main Switch Current Capacity		
i)	Rated normal current	1250 A	
ii)	Rated Short time withstand Current	31.5 kA for 3 Sec.	
iii)	Rated peak withstand current	2.5 times of short time withstand current	
iv)	Maximum magnetizing current (Make/ break capacity)	6 - 8 Amps.	
9	Earthing switch current capacity		
i)	Rated Short time withstand Current	31.5 kA for 3 Sec.	
ii)	Rated peak withstand current	2.5 times of short time withstand current	
iii)	Making capacity for discharging line charge		
10	Minimum clearances		
i)	In air between live parts and earth	630 mm	
ii)	In air between Phase to phase	630 mm	
iii)	Minimum ground clearance	4000 mm	



**Volume – 2 Schedules & Annexure**

**Schedule B17**

Sr. No.	Description	Data By Purchaser	Data by Supplier
11	Phase spacing	2000 mm (Project Specific)	
12	No. of breaks per circuit pole	Two for double break	
13	Nos. of insulators pedestal	Three stacks per phase of heavy duty post type insulators	
14	Main Switch Contacts		
i)	Type of Contact	High pressure relieving copper contacts (rotating blade features of twist mechanism). The moving arm enters the fixed female contact assembly developing high pressure.	
ii)	Material for rotating blade	Electrolytic tinned copper	
iii)	Material of contact	Silver plated electrolytic copper.	
15	Earth Switch Contacts		
i)	Type of Contact of Earth switch	High pressure banging type	
ii)	Material for earth switch blade	Electrolytic tinned copper	
iii)	Material of earth switch contact	Silver plated electrolytic copper.	
16	Thickness of Silver Coating	15 - 25 microns.	
17	Maximum current density	1.5 A /sq mm	
18	Type of bearing for rotating insulator stocks		
19	Number of auxiliary contacts		
i)	Isolator operating mechanism	10 NO + 10 NC	
ii)	Earthing Device	4 No + 4 NC	
20	Temperature rise	As per IS 9921	
21	Control supply voltage	220 V / 110 V / 50 V DC	
22	AC Aux. Supply (4 wire)	415 V $\pm$ 10%	
23	Inter Locking arrangement	Electrical and mechanical	

**Volume – 2 Schedules & Annexure**

**Schedule B17**

Sr. No.	Description	Data By Purchaser	Data by Supplier
24	Terminal connectors	Suitable for twin ACSR Zebra conductor	
25	Minimum creepage distance of insulator		
26	Type of control for		
i)	Disconnection switch	Motorised with Manual Facility	
ii)	Earthing switch	Manual	
27	Locking arrangement		
28	Rated mechanical terminal loads in addition to wind load acting on the equipment and short-circuit forces		
29	Total operating time of disconnection switch including that of its operating mechanism		
30	Weight of Isolators		
31	Post insulators		
i)	Make & type		
ii)	Height		
iii)	Voltage level		
iv)	Cantilever Strength		
v)	Torsional Strength		
vi)	Creepage Distance	Min 31mm/KV	
vii)	Basic insulation level (1 min. power frequency flashover voltage)		
	a) Dry	140 KV rms	
	b) Wet	140 KV rms	
viii)	Visible corona discharge voltage		
ix)	1.2/50 micro second impulse flashover voltage	325 KVp	
x)	Insulation class	A	
32	Drive Motor		
i)	Make		
ii)	KW Rating / rpm		
iii)	Rated current		
iv)	Frame size		
v)	Rated Voltage	415 V AC	
vi)	Degree of Protection	IP-55	
vii)	Insulation Class	B/F	
viii)	Duty		

**Volume – 2 Schedules & Annexure**

**Schedule B17**

	Bidders Name	:	_____
	Signature	:	_____
	Name	:	_____
	Designation	:	_____
Seal of Company	Date	:	_____

**SCHEDULE – B18**  
**CABLE TRAYS, ACCESSORIES AND TRAY SUPPORT, CONDUITS, PIPES**  
**AND DUCTS**

<b>1</b>	<b>General</b>	
a	Name of the Contractor	
b	Name of sub contractors, if any	
c	Applicable standards	
<b>2</b>	<b>Cable Trays and Fittings</b>	
a	Cable Trays and Fittings	
i.	Make	
ii.	Type	
iii.	Material	
	1. Thickness (mm)	
	2. Thickness of galvanization (microns)	
	3. Zinc coating per sq meter (gms)	
<b>3</b>	<b>Conduits , Fitting and Accessories</b>	
a	Pipes with fitting	
i.	Make	
ii.	Type	
iii.	Material	
	1. Thickness (mm)	
	2. Thickness of galvanization (microns)	
b	Flexible conduits with fittings and accessories	
i.	Make	
ii.	Type	
iii.	Material	
	1. Thickness (mm)	
	2. Thickness of galvanization (microns)	

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Seal of Company

Date : \_\_\_\_\_

**SCHEDULE – B19**  
**ACSR Conductor**

SI.NO.	DESCRIPTION	BRPL/BYPL Requirement	PARTICULARS
1.	Name of the material offered	XLPE Insulated ACSR Conductor	
2.	Maker's Name	Required	
3	Address and Phone No.		
4	Reference Standards	IS-398 Pt-3, IS-7098 Pt-1, IS 17778-80	
5	No.of strands/diameter of Galvanised steel wire/Al strand	Required	
6	Apporx.Dia over covered conductor		
7	Minimum Ultimate Tensile Strenght of Conductor	18.25	
8	Direction Of Lay	Successive layers shall have opposite directions of lay outermost layer being Right Handed	
9	Lay ratio of Aluminum wire	10-14	
10	Continuous max.current rating of ACSR Conductor in still air at an ambient temperature at 45 Deg C	Required	
11	Temperature rise for the above current	Required	
12	Short Circuit current rating of ACSR Conductor for 1sec	Required	
13	Module of elasticity of complete conductor	79	
14	Coefficient of linear expansion of complete conductor	$19.1 \times 10^{-6}$	
15	Cross sectional area	Required	
16	Nominal aluminium area	Required	
16.1	Conductivity and Grade of Al	61% EC Grade	
16.2	% Composition of steel wire	As Per spec	
17	Chemical composition certificate from NABL approved lab	Required	
18	Minimum breaking load		
18.1	Aluminum strand ( After Stranding )	Required	
18.2	Galvanised steel wire ( After Stranding )	Required	
19	Total Conductor	Required	
20	Max.Working tension of conductor	75% of UTS	
21	Resistance of Al conductor at 20Deg C(Max)	Required	
22	Weight		
22.1	Aluminium strand	Required	

**Volume – 2 Schedules & Annexure**

**Schedule B19**

22.2	Steel Strand	Required	
22.3	Conductor without insulation	Required	
22.4	Conductor with insulation	Required	
23	Purity of AL rod in %age	Required	
24	Zinc coating on steel wire		
24.1	Grade of Zinc	Electrolytic High Grade Zinc not less than 99.95% purity as per IS209-1992	
24.2	Min wt of Zinc Coating	Required	
24.3	No.& duration of dips of Zinc coating ( Before Stranding)	Required	
25	Type of Insulation	XLPE Type as per IS 7098	
25.1	Nominal thickness of XLPE insulation	1.6	
25.2	Min thickness of XLPE insulation	1.5	
25.3	Color of XLPE insulation	Black	
25.4	Tensile strength of Insulation ( Min )	12.5	
25.5	Percentage elongation at break of insulation ( Min)	200	
25.6	Insulation resistance test (Volume resistivity) Min	1x10 <sup>14</sup> at 27deg C 1x10 <sup>12</sup> at 90deg C	
26	Chemical composition test certificate of XLPE insulation material	Required, shall be weather proof and have property of protection against ultraviolet light having 2.5% black carbon content	
27	Drum	Required	
27.1	Ref IS	IS-1778-1980	
27.2	Gross weight of drum including weight of conductor	Required	
27.3	Standard length of each piece of conductor	3Km	
27.4	Non standard length	1% of the ordered quantity & no length less than 50% of the standard length	
28	Order quantity tolerance	(+/-)2%	Yes/No
29	Embossing	Name of manufacturer, Manufacture year, Manufacturing month, Type of conductor, BRPL/BYPL, P.ono & date	

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

Seal of Company

**SCHEDULE – C1**

**TECHNICAL DEVIATIONS FROM THE SPECIFICATION**

(This shall form part of Technical Bid)

All the technical deviation from the tender specification shall be listed out by the Bidder, para by para in this schedule. Deviation taken in covering letter, standard terms and/or body of the Bid but not listed herein will make the Bid liable for rejection as 'Irresponsive'

S.No.	Section/Sub-Section	Part	Para	Deviation	
Justification					
1	2	3	4	5	6

Certified that above are the only technical deviations from the tender Specification

Name of Firm : \_\_\_\_\_  
Signature of Bidder : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

Seal of Company

## SCHEDULE – C2

### COMMERCIAL DEVIATIONS FROM THE SPECIFICATION

(This shall form part of Technical Bid)

All the commercial deviation from the tender specification shall be listed out by the Bidder, para by para in this schedule. Deviation taken in covering letter, standard terms and/or body of the Bid but not listed herein will make the Bid liable for rejection as 'Irresponsive'.

S.No.	Section/Sub-Section Justification	Part	Para	Deviation
1	2	3	4	5
				6

Certified that above are the only technical deviations from the tender Specification

Name of Firm : \_\_\_\_\_  
Signature of Bidder : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

Seal of Company



**SCHEDULE – D**

**LIST OF DRAWINGS ENCLOSED WITH BID**

(This shall form part of Technical Bid)

S.No.	Drawing No	Title
1	2	3

Name of Firm : \_\_\_\_\_

Signature of Bidder : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

Seal of Company

**Volume – 2 Schedules & Annexure**

**SCHEDULE – E**

**SCHEDULE OF TEST**

(This shall form part of Technical Bid)

Tests as per the relevant Indian Standard except as modified and/or as additionally called for in the tender specification shall be performed. Detailed list of the type test certificates enclosed for the various equipments offered shall be listed in the schedule.

S.No.	Type of test	Equipment	Description
1	2	3	4

1.0 TYPE TESTS

2.0 TESTS  
– DURING MANUFACTURE

3.0 ROUTINE TESTS  
– ON COMPLETION OF MANUFACTURE

Name of Firm : \_\_\_\_\_

Signature of Bidder : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

Seal of Company

**Volume – 2 Schedules & Annexure**

**SCHEDULE – F**  
**LIST OF INSTRUMENTS, TESTING EQUIPMENTS, TOOLS AND TACKLES**  
**FOR ERECTION AND MAINTANANCE**

(This shall form part of Technical Bid)

S.No.	Description	Capacity	Quantity	Delivery
(1)	(2)	(3)	(4)	(5)

**1.0 INSTRUMENTS, TESTING EQUIPMENT, TOLLS & TACKLES FOR ERECTION**

(To be taken back by the Bidder after completion of job)

**2.0 INSTRUMENTS, TESTING EQUIPMENT, TOOLS & TACKLES FOR MAINTENANCE**

(To be taken back by the Bidder after completion of job)

**3.0 SPECIAL INSTRUMENTS, TSTING EQUIPMENT, TOOLS & TACKLES FOR ERECTION**

(To be taken back by the Bidder after completion of job)

**4.0 SPECIAL INSTRUMENTS, TSTING EQUIPMENT, TOOLS & TACKLES FOR MAINTENANCE**

(To be taken back by the Bidder after completion of job)

Name of Firm : \_\_\_\_\_

Signature of Bidder : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

Seal of Company

**Volume – 2 Schedules & Annexure**

**Schedule G**

**SCHEDULE – G**  
**LIST OF INSTALLATIONS**

S.No.	Purchaser	Project	PF Ref.	Brief Description	Value	Target Commissioning	Commissioned	Performance	Person to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10	11

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – H**  
**DELIVERY TERMS AND CONDITIONS**

1	Quoted for all the items & in the manner as called for in Specification	*Yes/No
1.1	If not, furnish details of deviations	
2	Price FOR site delivery basis	
2.1	Freight:	
	1 Applicable rate	* Not included/included
2.2	Transit Insurance including forty five(45) days storage	
	1 Applicable rate	* Not included/included
2.3	Excise duty	
	1 Applicable rate	* Not included/included
2.4	Sales tax	
	1 Applicable rate	* Not included/included
2.5	Are quoted price firm	*Yes/No
3	Delivery from LOI	
3.1	Supply	
3.2	Erection	
3.3	Testing & commissioning	
3.4	Whether penalty clause acceptable	*Yes/No
4	Validity	
5	Terms of payment	
5.1	As per tender specification	*Yes/No
5.2	If not, give details	
6	Guarantee period	
6.1	Is it as per the tender specification	*Yes/No
6.2	If not, state alternative guarantee period acceptable	
7	Earnest money furnished	*Yes/No
8	Agreeable to furnish security deposit as per the tender specification	*Yes/No
8.1		*Yes/No
9	Agreeable to furnish performance Bank as per the tender specification	*Yes/No
10	Correspondence, drawings, test certificates, instruction manuals, BAR/PERT charts progress reports etc. shall be furnished in number of copies as per distribution schedule attached to the tender specification	*Yes
11	Agreeable to approval of above documents in our (4) weeks from date of receipt as per tender specification	Yes
12	Agreeable to commercial as well as technical terms & conditions of the tender specification, unless listed deviations are accepted	Yes
13	Commencing & completion of submission of drawings from LOI	

Seal of Company

Bidders Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

**SCHEDULE – I**

**SCHEDULE OF RECOMMENDED SPARES**

Bidder shall offer the prices for spares for destination, rate of taxes & duties to be considered shall be indicated.

S.No.	Description	Quantity	Unit Price	Total Price
1	2	3	4	5

Seal of Company

Bidders Name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Name : \_\_\_\_\_  
Designation : \_\_\_\_\_  
Date : \_\_\_\_\_

**SCHEDULE – J**

**DECLARATION**

(This shall form part of Technical Bid)

I, \_\_\_\_\_ certify that all the typed data & information pertaining to the subject tender specification are correct & are true representation of the equipment covered by our formal Bid No \_\_\_\_\_ dated \_\_\_\_\_.

I hereby, certify that I am duly authorized representative of the Bidder whose name appears above my signature.

Bidders Name : \_\_\_\_\_

Authorized Representative  
Signature : \_\_\_\_\_

Authorized Representative  
Name (Typed) : \_\_\_\_\_

Authorized Representative  
Designation : \_\_\_\_\_

Seal of Company Date : \_\_\_\_\_

Bidder's Intent : The bidder hereby agrees to fully comply with the requirements & intents of the subject tender specification for the price(s) indicated

Authorized Representative  
Signature : \_\_\_\_\_



## **Annexure - L**

### **I. Technical specification for New Grids 24 x 7 Operational & after Sale service support for a period of 6 Months**

#### **Scope:**

24x7 (8 hours per shift) Operational & After Sale service support for equipment supplied by Contractor after handing over of Grid by Contractor to BRPL

The Contractor shall depute 24x7 trained Operational staff in three shifts to work under the direction of BRPL System Operation.

Each shift consists of One Operator (Minimum ITI qualified) & one helper (skilled worker).

Qualification documents of Manpower assigned shall be submitted to BRPL for approval.

On call trained After Sale staff to take care of any After Sale service requirement, shall be kept available 24x7

It shall cover the following:

#### **Operation:**

- Knowledge of sequence of operation (bidder to provide flow chart for the same in laminated form so that the same may be pasted on grid notice board).
- Competency level of deputed staff in electrical as well as mechanical operations.
- All necessary Tools & tackles and measuring & testing instruments shall be available with the Operation team

#### **Maintenance:**

- Scheduled After Sale services as per the OEM recommendation to be taken care by the contractor

#### **Breakdown:**


- Attending any breakdown in equipment supplied and replacement of faulty parts (within 10-12 hrs).
- Presence of experienced engineer during entire restoration sequence till equipment gets energized.
- All necessary Tools & tackles and measuring & testing instruments shall be available with the Breakdown team

#### **General Guidance:**

- Work force required to attend the outages – built a QRT (Quick Response Team to attend breakdown during that tenure).
- Special Tools & tackles and spares necessary for attending outage. - One set of special tools & tackles to be handed over to user during HOTO.
- Skill level suitable to carry out the operation for 66kVkv.

[illegible]

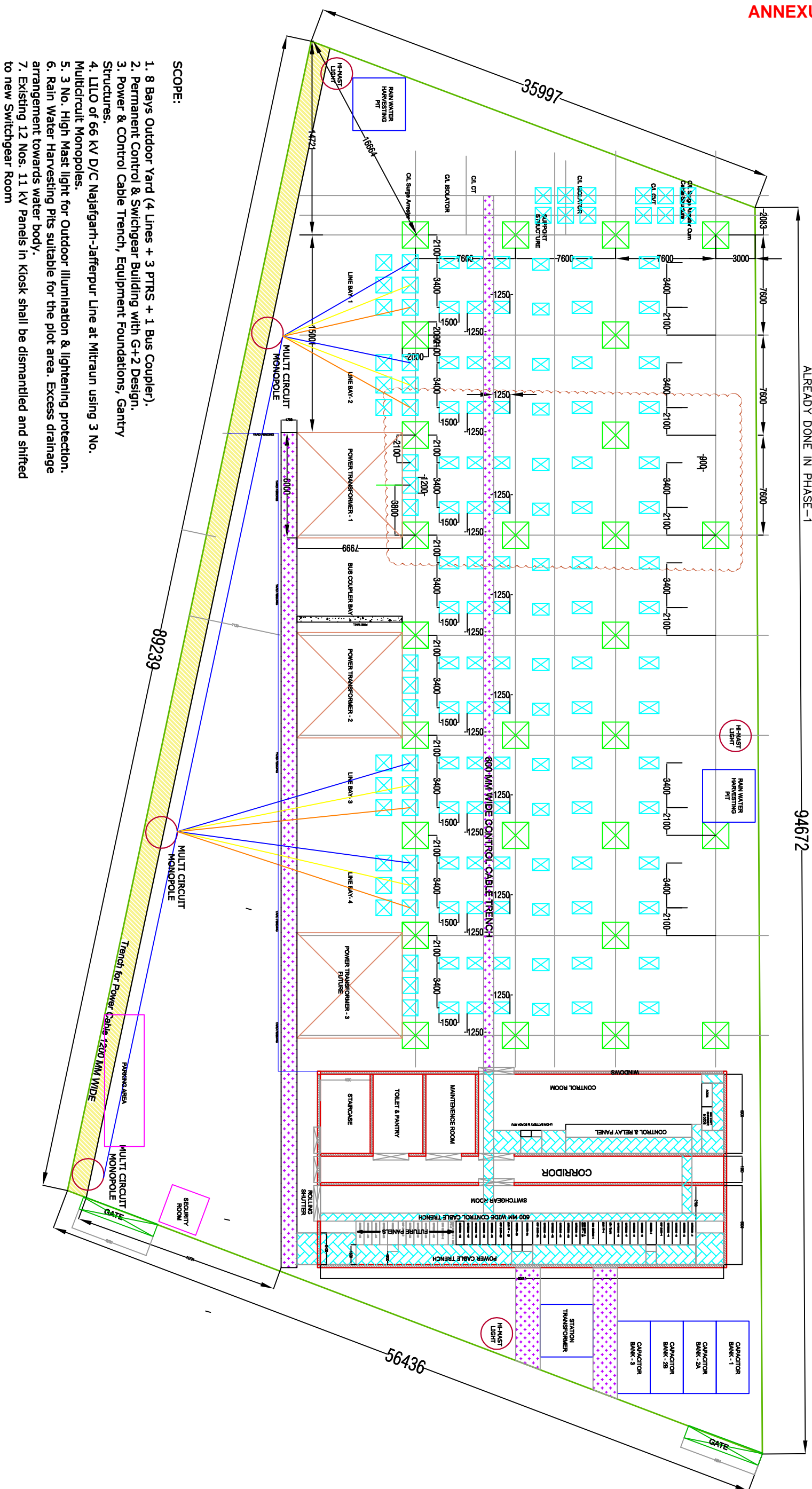
1. Foundation indicated in Cloud to be made
2. Power Transformer + Local Transformer Foundations
3. Power & Control Cable Trenches
4. Kiosk for Switchgear Panels & Control Room

												BSES Rajdhani Power Limited BSES BILWAAN, Narni Place, New Delhi - 110017	
02	REVISION	19.08.19	US	US	US	DRAWN	SK	TITLE:- LAYOUT OF 2X25MVA 66/11KV MITARON GRID					
01	REVISED DRAWING AFTER SITE VISIT	16.08.19	AS	AS	AS	CHECKED	AS						
00	FIRST DRAWING	01.08.19	BG	US	AS	APPD.	BG						
REV. No.	DESCRIPTION	DATE	BY	PPPD.	CHKD.	APPR.	DWG No.:- BRLP-MITARON-0001	SHEET 1 OF 1	REV. 00	VER. 01			



# SUGGESTIVE LAYOUT OF MITRAUN PHASE - 2

EQUIPMENT WORK UNDER CLOUD IS  
ALREADY DONE IN PHASE-1



- SCOPE:
1. 8 Bays Outdoor Yard (4 Lines + 3 PTRS + 1 Bus Coupler).
  2. Permanent Control & Switchgear Building with G+2 Design.
  3. Power & Control Cable Trench, Equipment Foundations, Gantry Structures.
  4. LHO of 66 KV D/C Najafgarh-Jafferpur Line at Mitraun using 3 No. Multicircuit Monopoles.
  5. 3 No. High Mast light for Outdoor illumination & lightening protection.
  6. Rain Water Harvesting Pits suitable for the plot area. Excess drainage arrangement towards water body.
  7. Existing 12 Nos. 11 KV Panels in Kiosk shall be dismantled and shifted to new Switchgear Room

Item#	Quantity	Title/Name, designation, material, dimension etc	Article No./Ref. reference
Designed by Admin/IV	Checked by Admin/IV	Approved by - Date Approved by - Date	File Name Date
		--	15/09/2020
			MIS

**BS&S**

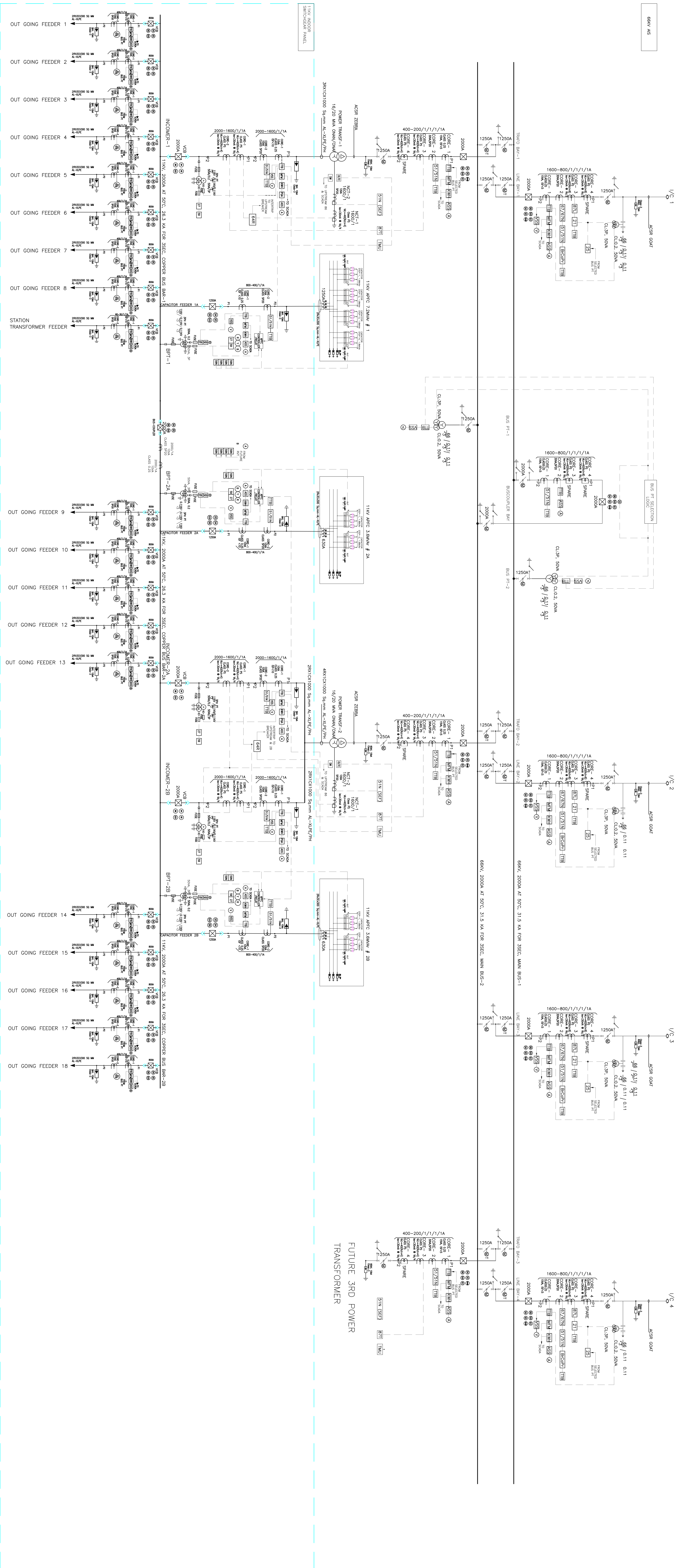
SUGGESTIVE LAYOUT - MIRAUN PH - 2

BRP/CE/S/MIRAUN\_Php-2/001

Editor  
TENDER SHEET-1

Sheet





						<div><div><div><div></div><div>BSES</div></div><div>BSES Rajdhani Power Limited</div><div>BSES BRAWAN</div><div>Nehru Place, New Delhi - 100019</div></div></div>									
						DRAWN	BC	TITLE:-							
						CHECKED	US, AS	SLD OF 66/11KV MITRAON GRID							
00	FIRST DRAWING	15.01.21	BG	US	AS	KS	APPR.	DATE	15.01.21	KS					
REV. No.	DESCRIPTION	DATE	PRPD BY	CHKD. BY	APPR. BY	SCALE		N/S	DWG No. :- BRPL-MITRR-0001	SHEET 1 OF 1	REV 00	VER 01			



## GEOTECHNICAL REPORT

### PROPOSED 66/11 KV SUBSTATION AT MITRAON, NEW DELHI

**SUBMITTED TO:**

**M/S. BSES RAJDHANI POWER LIMITED**

1<sup>st</sup> Floor, C-Block, BSES Bhawan, Nehru Place, Delhi – 110 019.

Project No. 2003 6

Dated. June, 20 20

Revision-0

---

## **RAO ENGINEERING ENTERPRISES**

Geotechnical Consultants, Land Surveyors, Piling Contractor & GPR Surveyors

**Address:**

91-D-3, Street-1, East Moti Bagh, Old Rohtak Road,  
Sarai Rohilla, New Delhi - 110007

**Phone :**

011-23698806, 23691434  
9310502435, 9811108174

**E-mail :**

raogr@yahoo.com,  
raoraoengg@rediffmail.com





June 25<sup>th</sup>, 2020

Project No. 20036

**M/s. BSES Rajdhani Power Limited**

1st Floor, C-Block, BSES Bhawan,  
Nehru Place, Delhi – 110 019.

**Sub: Final Report on Soil Investigation Work for Proposed 66/11 Kv Substation At Mitraon, New Delhi**

We have carried out the soil investigation work accordance with your Work Order No. SER/DSC/23563894. We thank you for your business and hope that you are satisfied with our services rendered.

This Final Report presents our findings based on the soil investigation conducted by us at the project site. This report presents the field and laboratory test data along with our engineering recommendations, which shall help you in deciding the optimum foundation arrangement for use on site.

We have prepared this report based on our findings on site as well as our experience gained in our previous projects completed over the past 15 years. We appreciate the opportunity to perform this investigation for you and have pleasure in submitting this report. Please contact us when we can be of further service to you.

Yours faithfully,  
RAO ENGINEERING ENTERPRISES



(G.R.RAO)



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3.0 <b>LABORATORY TESTS</b>	2
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## 1.0 **INTRODUCTION**

### Project Description

This soil investigation work, whose results are being presented herewith, has been carried out for Proposed 66/11 Kv Substation At Mitraon, New Delhi.

M/s. Rao Engineering Enterprises has been retained by M/s. BSES Rajdhani Power Limited for carrying out the geotechnical investigation at the project site.

### 1.1 Aim of Soil Investigation

Soil investigation has been conducted at the site in order to evaluate the parameters required for design of foundations. These parameters are:

- a) Type of foundation on which the proposed super structure will be supported.
- b) Depth of foundation, and
- c) Allowable bearing pressure at the founding level.

To evaluate these parameters, following engineering properties of the Sub-Soil have been studied:

Sub-soil penetration resistance characteristics which have been determined insitu. Properties like particle size distribution, atterberg's limits, bulk density, moisture content, and shear strength parameters; which have been determined in the laboratory by conducting testing of both disturbed as well as undisturbed samples.

### 1.2 Scope of Work

The stipulated scope of work comprised of the following:

1. Mobilization of equipment and personnel to the site and back.
2. Sinking two (2) boreholes to specified depths, observing ground water table levels, conducting required field and laboratory tests and their analysis.
3. Preparation and submission of technical report in triplicate.

## 2.0 **FIELD INVESTIGATIONS**

### 2.1 Soil Borings

The boreholes were progressed using mechanized shell and auger drilling rig to the specified depth. The diameter of the borehole was 150 mm. Where caving of the borehole occurred, casing was used to keep the borehole stable. The work was in general accordance with IS: 1892-1979.

Standard Penetration Tests (SPT) were conducted in the boreholes at 1.5 m depth interval up to 15 m depth and 3 m depth interval below it. The tests were conducted by connecting a split spoon sampler to 'A' rods and driving it by 45 cm using a 63.5 kg hammer



falling freely from a height of 75 cm. The tests were conducted in accordance with IS: 2131-1981.

The number of blows for each 15 cm of penetration of the split spoon sampler was recorded. The blows required to penetrate the initial 15 cm of the split spoon for seating the sampler is ignored due to the possible presence of loose materials or cuttings from the drilling operation. The cumulative number of blows required to penetrate the balance 30 cm of the 45 cm sampling interval is termed the SPT value or the 'N' value.

Where the split spoon sampler did not penetrate the initial 15 cm seating in a total of 100 blows, it is indicated "Ref" for an indicated amount of penetration. The 'N' values are presented on the soil profile for each borehole.

Disturbed samples were collected from the split spoon after conducting SPT. The samples were preserved in transparent polythene bags. Undisturbed soil samples were collected by attaching 75 mm diameter thin walled 'Shelby' tubes and driving the sampler by light-hammering using a 63.5 kg hammer in accordance with IS: 2132-1986. The tubes were sealed with wax at both ends. All samples were transported to our laboratory for further examination and testing.

## 2.2 Groundwater

Groundwater level was measured in the boreholes after drilling and sampling was completed. The measured water levels are recorded on the individual soil profiles.

## 3.0 LABORATORY TESTS

Laboratory tests have been conducted on various selected soil and groundwater samples in the laboratory:

Laboratory Test	IS Code Referred
Bulk Density	By calculations
Natural Moisture Content	IS : 2720 (Part-2)-1973, RA-2010
Specific Gravity	IS : 2720 (Part-3)-1980, RA-2007
Grain Size Analysis	IS : 2720 (Part-4)-1985, RA-2010
Liquid Limit and Plastic Limit	IS : 2720 (Part-5)-1985, RA-2010
Consolidated Drained Direct Shear Test	IS : 2720 (Part-13)-1986, RA-2010

## 4.0 GENERAL SITE CONDITIONS

### 4.1 Site Stratigraphy

A heterogenous fill of sandy silt with brick bats was met to about 10.5-12.0 m depth below EGL. Below fill, sandy silt to about 20.0-22.0 m depth which is underlain by silty sand to the final explored depth of 25.45 m below EGL.

The field SPT N-values range from 6 to 23 to about 12.0 m depth and range from 39 to 56 to about 21.0 m depth below EGL. Below this, SPT N-values range from 55 to 72 to the final explored depth of 25.45 m depth.



All test results are presented on the individual soil profiles on Sheet No. 2 to 7. A summary of the borehole profiles is illustrated on Sheet No. 8. Plots of field and corrected SPT values versus depth are presented on Sheet No. 9 & 10, respectively.

#### 4.2 Groundwater

Based on our measurements in the completed boreholes, groundwater was met at 16.4~16.5 m depth below EGL during the period of our field investigations (June, 2020).

Fluctuations may occur in the measured ground levels due to seasonal variations in rainfall, surface evaporation rates.

### 5.0 **FOUNDATION ANALYSIS**

#### 5.1 General

For designing the foundation system, the following parameters are required:

- a) Suitable type of foundation on which the proposed super-structure can be supported.
- b) Depth of these foundations, and
- c) Allowable bearing pressure at the founding level corresponding to various footing sizes.

A suitable foundation for any structure should have an adequate factor of safety against exceeding the bearing capacity of the supporting soils. Also the vertical movements due to compression of the soils should be within tolerable limits for the structure. We consider that foundation designed in accordance with the recommendations given herein will satisfy these criteria.

#### 5.2 Liquefaction Susceptibility Assessment

Liquefaction is defined as the transformation of a granular material from a solid to a liquefied state as a consequence of increased pore-water pressure and reduced effective stress (Marcuson, 1978)<sup>(1)</sup>. Increased pore pressure may be induced by the tendency of granular materials to compact when subjected to cyclic shear deformation, such as in the event of an earthquake.

As per IS: 1893-2016, liquefaction is likely to occur in loose fine sand below water table.

The following points are highlighted for the soils encountered at the site, with reference to the liquefaction susceptibility assessment:

- Based on the data available, the SPT values in the sand strata less the limits prescribed in IS: 1893 (Part-1) – 2016 for liquefaction potential.

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<sup>(1)</sup> Marcuson, W.F. (III) (1978), "Definition of terms related to liquefaction", J. Geotech Engg. Div., SCE, 104(9), 1197-1200.



- The sandy silt layers are not likely to liquefy due to the high fines content and plasticity.
- Groundwater was met at 16.4~16.5 m depth below existing ground level during the period of our field investigation (June, 2020).

As per our assessment of the available data, we are of the opinion that liquefaction is not likely to occur at the project site in the event of an earthquake (Consider groundwater at 12.0 m depth below EGL).

According to Fig.1 of IS: 1893 (Part-1)-2016 showing seismic zones, the project site falls under Zone-IV. The design for seismic forces should be done considering the project site in Zone-IV.

### 5.3 Foundation Type and Depth

Type of foundation to be adopted for a particular structure depends upon the loading intensity at the foundation level and the configuration of loading points.

Reviewing the stratigraphy of the site on the basis of completed borehole data & field SPT values, We are of the opinion that pile foundations are feasible foundation scheme to support the structural load.

We recommend RCC bored cast in-situ may be used to support the structural loads. Our recommended safe pile capacities for 400 mm, 500 mm and 600 mm diameter bored piles with cut-off-level of about 1.0 m below EGL are presented in Section 6.0.

### 5.4 Method of Analysis (Bored Cast-in-situ Pile Foundations)

The ultimate pile compressive capacity has been computed using the following equation as given in IS 2911: Part-1, Section 2 (2010).

$$Q_{ult} = \left[ \sum_{i=1}^n f_s A_s L_i \right] + q_u A_p$$

$$= \left[ \sum_{i=1}^n (\alpha c_i + p_i k \tan \delta_i) A_s L_i \right] + \left[ c_p N_c + q_p N_q + \frac{1}{2} \gamma D N_\gamma \right] A_p$$

where:

$Q_{ult}$	=	ultimate pile capacity
$f_s$	=	unit skin friction
$\alpha$	=	adhesion factor
$c_i$	=	cohesion intercept in $i$ th layer
$p_i$	=	overburden pressure at centre of $i$ th layer
$k$	=	coefficient of lateral earth pressure
$\delta_i$	=	angle of friction between soil and pile (taken as equal to $\phi_i$ ) for the $i$ th layer



$A_s$	=	<i>surface area of pile per m length</i>
$L_i$	=	<i>length of pile section in <math>i</math>th layer</i>
$c_p$	=	<i>cohesion intercept in bearing strata</i>
$q_u$	=	<i>unit end bearing</i>
$q_p$	=	<i>effective overburden pressure at pile toe</i>
$N_c, N_q, N_\gamma$	=	<i>bearing capacity factors, which are a function of <math>\phi</math> in the bearing strata</i>
$A_p$	=	<i>pile cross sectional area</i>

The overburden pressure is considered to become constant below a depth of 15 pile diameters.

The lateral load carrying capacity of bored piles has been computed based on IS: 2911 (Part-I / Sec-2), 2010. The pile head is assumed to be fixed. The lateral load carrying capacity of pile has been computed for a permissible horizontal deflection of 5 mm using the following equation for fixed head pile:

$$Q = \frac{12 y E I}{(L_1 + L_f)^3}$$

where:

$Q$	=	<i>lateral load</i>
$E$	=	<i>the Young's modulus of pile material</i>
$I$	=	<i>moment of inertia of pile cross section.</i>
$L_f$	=	<i>depth of fixity</i>
$L_1$	=	<i>length of pile section below cut-off-level that may not contribute significantly to lateral resistance (in loose/weak soils)</i>
$y$	=	<i>horizontal deflection</i>

## 6.0 **RECOMMENDATIONS**

Pile capacity analysis for RCC bored cast-in-situ piles for the proposed structure has been done considering the following boundary conditions:

- Pile cut-off-level : 1.0 m below EGL
- Groundwater Level : Considered at 12.0 m depth for worst condition
- Overburden Pressure : Assumed to become constant below 15 times pile diameters
- Pile Head : Fixed Head Condition (for lateral capacity analysis)

The following table presents our recommended safe pile capacities for 400 mm, 500 mm and 600 mm diameter bored piles at the sites of the proposed structure:



Pile Diameter, mm	Pile Length below COL, m	Recommended Pile Capacities, MT		
		Compression	Pullout	Lateral
400	15	18	11	7.1
	17	24	15	
	19	29	18	
500	15	33	17	8.8
	17	42	23	
	19	50	29	
600	15	54	25	10.6
	17	66	33	
	19	78	42	

The following points are highlighted with reference to the above-recommended capacities:

1. The above values are based on IS: 2911(Part-1 Section 2) -2010 and include safety factor of 2.5 for compressive loads, and a safety factor of 3.0 for uplift loads.
2. Safe pile capacities for piles of intermediate lengths may be interpolated linearly between the values given above.
3. It should be ensured that the bottom of the pile bore is cleaned properly before casting the pile. This is important because the soil particles tend to settle down at the bottom of the pile bore, which may cause reduction in pile capacities.
4. The capacities given above may be taken as a guideline for initial design. Final pile capacities should be confirmed by conducting initial pile load tests as per IS: 2911-Part-IV. Also, routine load tests should be conducted on sufficient working piles to ensure that the piles are safe for the design loads.
5. Low strain pile integrity tests (PIT) should be done on all working piles as a quality check.

## 7.0 **CHEMICAL ATTACK**

Results of chemical test on selected soil & groundwater samples are presented on Sheet No, 18.

The results indicate that the soils contain 0.13-0.15 percent sulphates and 0.02-0.05 percent chlorides. The groundwater contains 290-312 mg / litre of sulphates and 181-212 mg / litre of chlorides. The pH value of soil is 7.3-7.6 and that of groundwater is 7.2-7.5.

IS: 456-2000 recommends that precautions should be taken against chemical degradation of concrete if

- sulphates content of the soils exceeds 0.2 percent, or



- groundwater contains more than 300 mg /litre of sulphates ( $\text{SO}_3$ ).

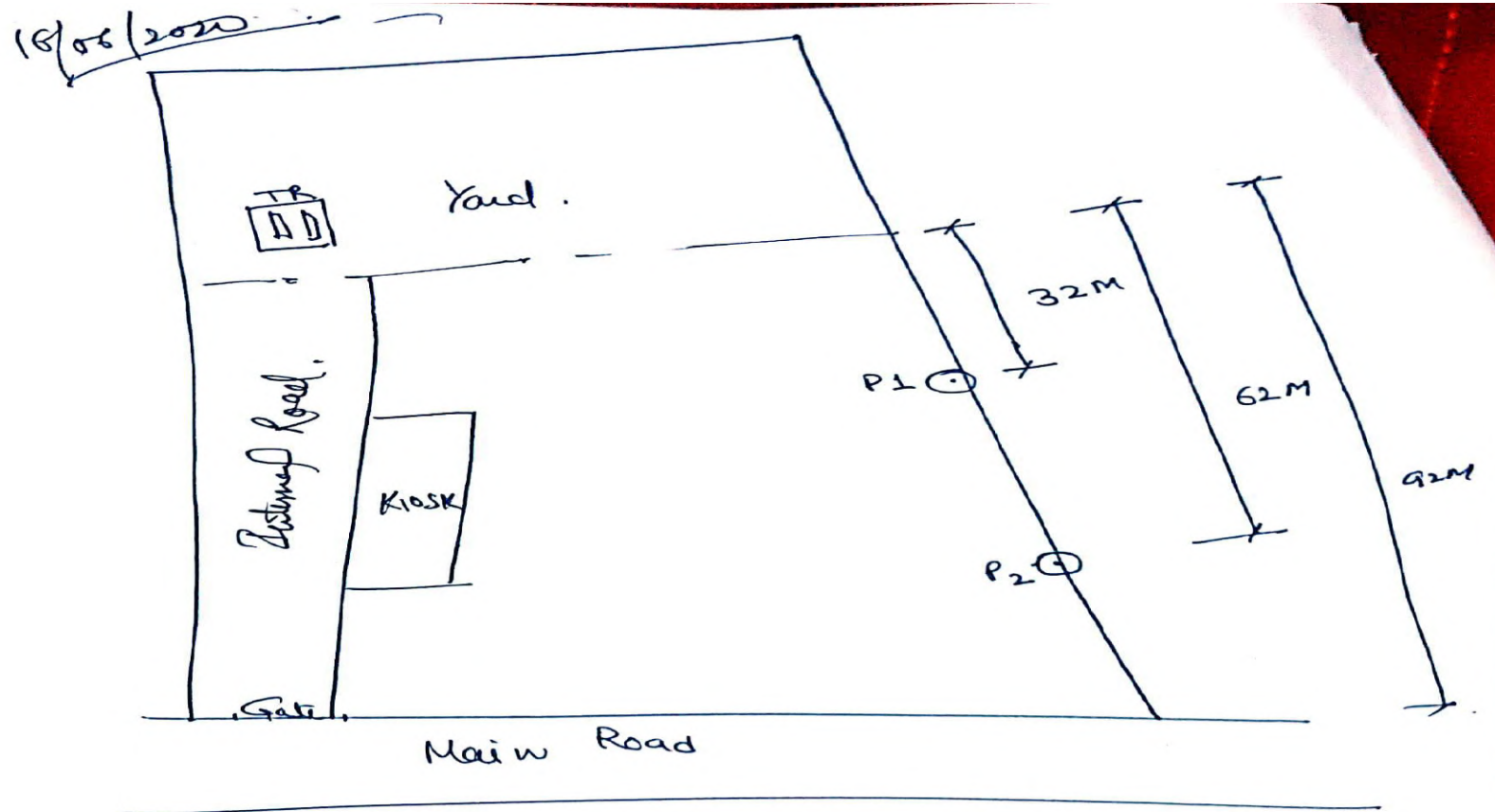
Comparing the test results with these specified limits, the sulphate content of the groundwater is lower than the specified limit. Therefore, strata at the site may be treated in **Class-2** category as described on IS: 456-2000.

In our opinion, the soil at site are aggressive to foundation concrete. We recommend the following measures to limit the potential for chemical attack:

- (1) The cement content in pile cap and pile concrete should be at least 400 & 330  $\text{kg/m}^3$  respectively.
- (2) Water cement ratio in foundation concrete should generally not exceed 0.50.
- (3) A clear concrete cover over the reinforcement steel of at least 50 mm should be provided for all foundations.
- (4) Foundation concrete should be densified adequately using a vibrator so as to form a dense impervious mass.

#### 8.0 **VARIABILITY IN SUBSURFACE CONDITIONS**

Subsurface conditions encountered during construction may vary somewhat from the conditions encountered during the site investigation. In case significant variations are encountered during construction, we request to be notified so that our engineers may review the recommendations in this report in light of these variations.



P1 & P2 (Points for soil testing)

Layout plan ~~for~~ 66/11 Kr grid station at Mitraon

Plan of Field Investigations



**Borehole Log (BH-P1)**

Structure : 66/11kv sub-station, Mitraon

Ground Water Level : 16.5 m

Drilling : Shell &amp; Auger

Termination Depth : 25.45 m

Start Date : 16-Jun-20

Finish Date : 17-Jun-20

Scale	Depth, m	Sample Designation	Groundwater depth, m	SPT		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Standard Penetration Test Results	Grain Size Analysis				Atterberg Limits			Specific Gravity	Density		Moisture Content (%)	Shear Tests	
				Field Value, N	Corrected Value, N"					Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gm/cm <sup>3</sup> )	Dry Density (gm/cm <sup>3</sup> )		Cohesion Intercept, 'c' (kg/cm <sup>2</sup> )	Angle of Internal Friction, 'φ' (degrees)
	0.5	DS1																				
	1.5	SPT1		9	9																	
	2.3	UDS1																1.67	1.53	8.9		
	3.0	SPT2		13	13																	
	4.5	SPT3		11	11																	
	5.3	UDS2					Fill: silty sand with brick bat& stone peccesis											1.71	1.55	10.2		
	6.0	SPT4		8	8																	
	7.5	SPT5		15	15																	
	8.3	UDS3																1.79	1.62	10.5		
	9.0	SPT6		23	23																	
								10.5														

**Borehole Log (BH-P1)**

Structure : 66/11kv sub-station, Mitraon

Ground Water Level : 16.5 m

Drilling : Shell &amp; Auger

Termination Depth : 25.45 m

Start Date : 16-Jun-20

Finish Date : 17-Jun-20

Scale	Depth, m	Sample Designation	Groundwater depth, m	SPT		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Standard Penetration Test Results	Grain Size Analysis				Atterberg Limits			Specific Gravity	Density		Moisture Content (%)	Shear Tests	
				Field Value, N	Corrected Value, N"				<div> <div></div> Field Value, N           <div></div> Corrected Value, N"         </div>	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gm/cm <sup>3</sup> )	Dry Density (gm/cm <sup>3</sup> )		Cohesion Intercept, 'c' (kg/cm <sup>2</sup> )	Angle of Internal Friction, 'φ' (degrees)
	10.5	SPT7		58	46		Light grey sandy silt of low plasticity (ML-CL)			5	21	68	6	24.5	18.9	5.6	2.66	1.90	1.68	13.2	0.0	30.0
	11.3	UDS4																				
	12.0	SPT8		79	59																	
	13.5	SPT9		73	52									24.2	17.9	6.3						
	14.3	UDS5								4	26	65	5				2.65	1.93	1.69	14.1		
	15.0	SPT10		71	48																	
			16.5																			
	17.3	UDS6								3	24	67	6				2.66	2.01	1.70	18.5		
	18.0	SPT11		56	25									24.6	18.9	5.7						
								20.0														
	20.3	UDS7					Light gret silty sand (SM)			0	57	43	0				2.63	1.97	1.68	17.4	0.0	32.0

**Borehole Log (BH-P1)**

Structure : 66/11kv sub-station, Mitraon

Ground Water Level : 16.5 m

Drilling : Shell &amp; Auger

Termination Depth : 25.45 m

Start Date : 16-Jun-20

Finish Date : 17-Jun-20

Scale

Depth, m	Sample Designation	Groundwater depth, m	SPT		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Standard Penetration Test Results	Grain Size Analysis				Atterberg Limits			Specific Gravity	Density		Moisture Content (%)	Shear Tests	
			Field Value, N	Corrected Value, N"				<div> <div></div> Field Value, N           <div></div> Corrected Value, N"         </div>	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gm/cm <sup>3</sup> )	Dry Density (gm/cm <sup>3</sup> )		Cohesion Intercept, 'c' (kg/cm <sup>2</sup> )	Angle of Internal Friction, 'φ' (degrees)
21.0	SPT12		55	24		Light grey silty sand (SM)															
23.3	UDS8																				
24.0	SPT13		57	24																	
25.0	SPT14		67	27			25.5														
							30.0														

**Borehole Log (BH-P2)**

Structure : 66/11kv sub-station, Mitraon

Ground Water Level : 16.4 m

Drilling : Shell &amp; Auger

Termination Depth : 25.45 m

Start Date : 17-Jun-20

Finish Date : 19-Jun-20

Scale	Depth, m	Sample Designation	Groundwater depth, m	SPT		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Standard Penetration Test Results		Grain Size Analysis				Atterberg Limits			Specific Gravity	Density		Moisture Content (%)	Shear Tests	
				Field Value, N	Corrected Value, N"						Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gm/cm <sup>3</sup> )	Dry Density (gm/cm <sup>3</sup> )		Cohesion Intercept, 'c' (kg/cm <sup>2</sup> )	Angle of Internal Friction, 'φ' (degrees)
	0.5	DS1																					
	1.5	SPT1		6	6																		
	2.3	UDS1																	1.65	1.53	7.8		
	3.0	SPT2		12	12																		
	4.5	SPT3		13	13																		
	5.3	UDS2					Fill: Silty sand with brick bat & stone picises												1.69	1.56	8.5		
	6.0	SPT4		9	9																		
	7.5	SPT5		16	16																		
	8.3	UDS3																	1.73	1.59	8.9		
	9.0	SPT6		10	10																		

**Borehole Log (BH-P2)**

Structure : 66/11kv sub-station, Mitraon

Ground Water Level : 16.4 m

Drilling : Shell &amp; Auger

Termination Depth : 25.45 m

Start Date : 17-Jun-20

Finish Date : 19-Jun-20

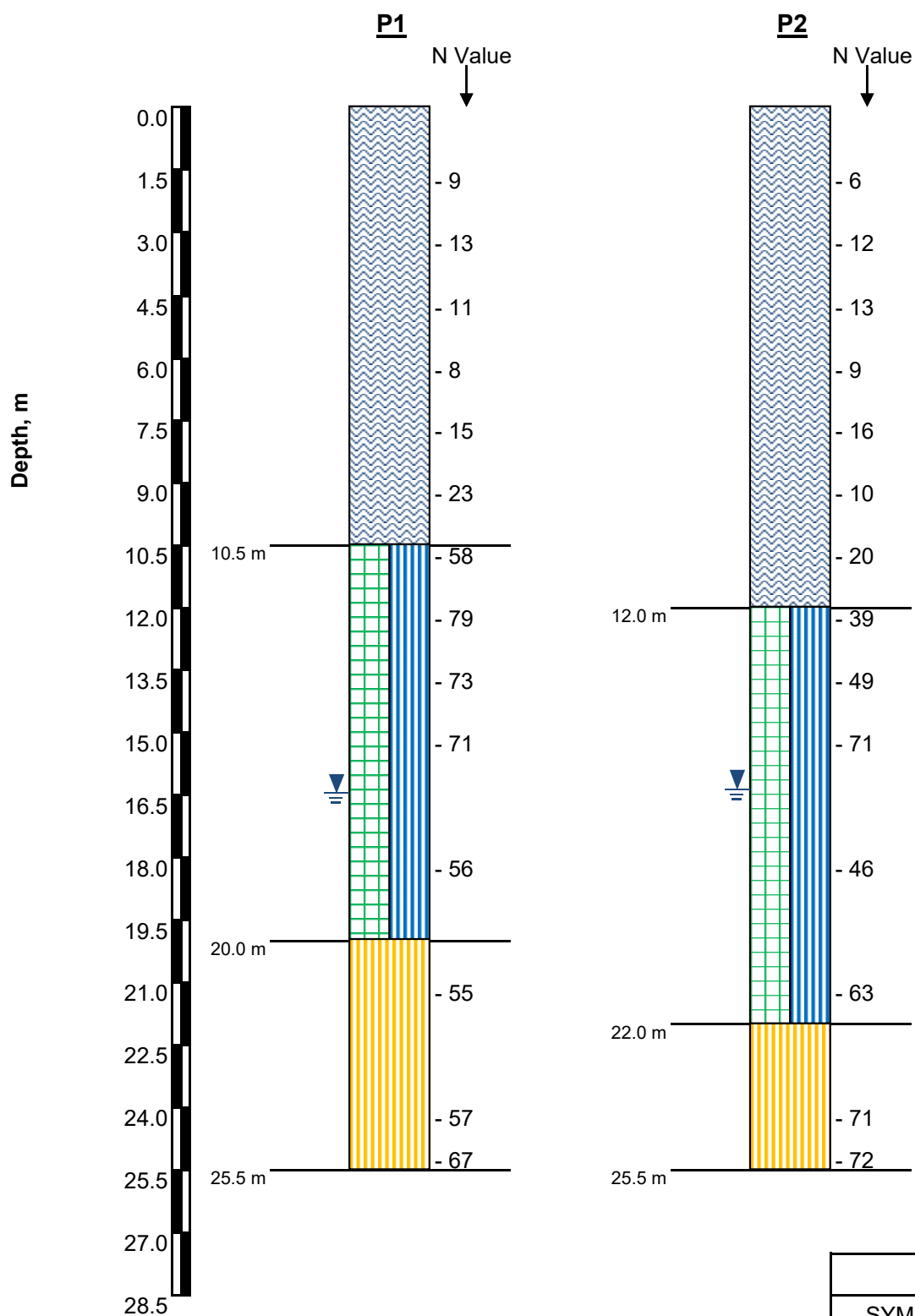
Scale	Depth, m	Sample Designation	Groundwater depth, m	SPT		Symbol	SOIL DESCRIPTION	Depth of Strata, (m)	Standard Penetration Test Results	Grain Size Analysis				Atterberg Limits			Specific Gravity	Density		Moisture Content (%)	Shear Tests	
				Field Value, N	Corrected Value, N"				<div> <div></div> Field Value, N           <div></div> Corrected Value, N"         </div>	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid (%)	Plastic (%)	Plasticity Index (%)		Bulk Density (gm/cm <sup>3</sup> )	Dry Density (gm/cm <sup>3</sup> )		Cohesion Intercept, 'c' (kg/cm <sup>2</sup> )	Angle of Internal Friction, 'φ' (degrees)
	10.5	SPT7		20	20		Fill: Dark grey sandy silt															
	11.3	UDS4						12.0		3	33	60	4					1.84	1.60	15.2		
	12.0	SPT8		39	29		Light grey sandy silt of low plasticity (ML-CL)			3	21	70	6				2.66					
	13.5	SPT9		49	35																	
	14.3	UDS5												24.6	19.5	5.1		1.89	1.66	13.9	0.0	31.0
	15.0	SPT10		71	48					5	19	71	5				2.65					
	16.4		16.4																			
	17.3	UDS6																2.01	1.69	18.8		
	18.0	SPT11		46	22									24.1	18.7	5.4						
	20.3	UDS7								0	22	72	6				2.66	2.02	1.72	17.6		

Ground Water Level : 16.4 m  
Termination Depth : 25.45 m

Drilling :	Shell & Auger
Start Date :	17-Jun-20
Finish Date :	19-Jun-20

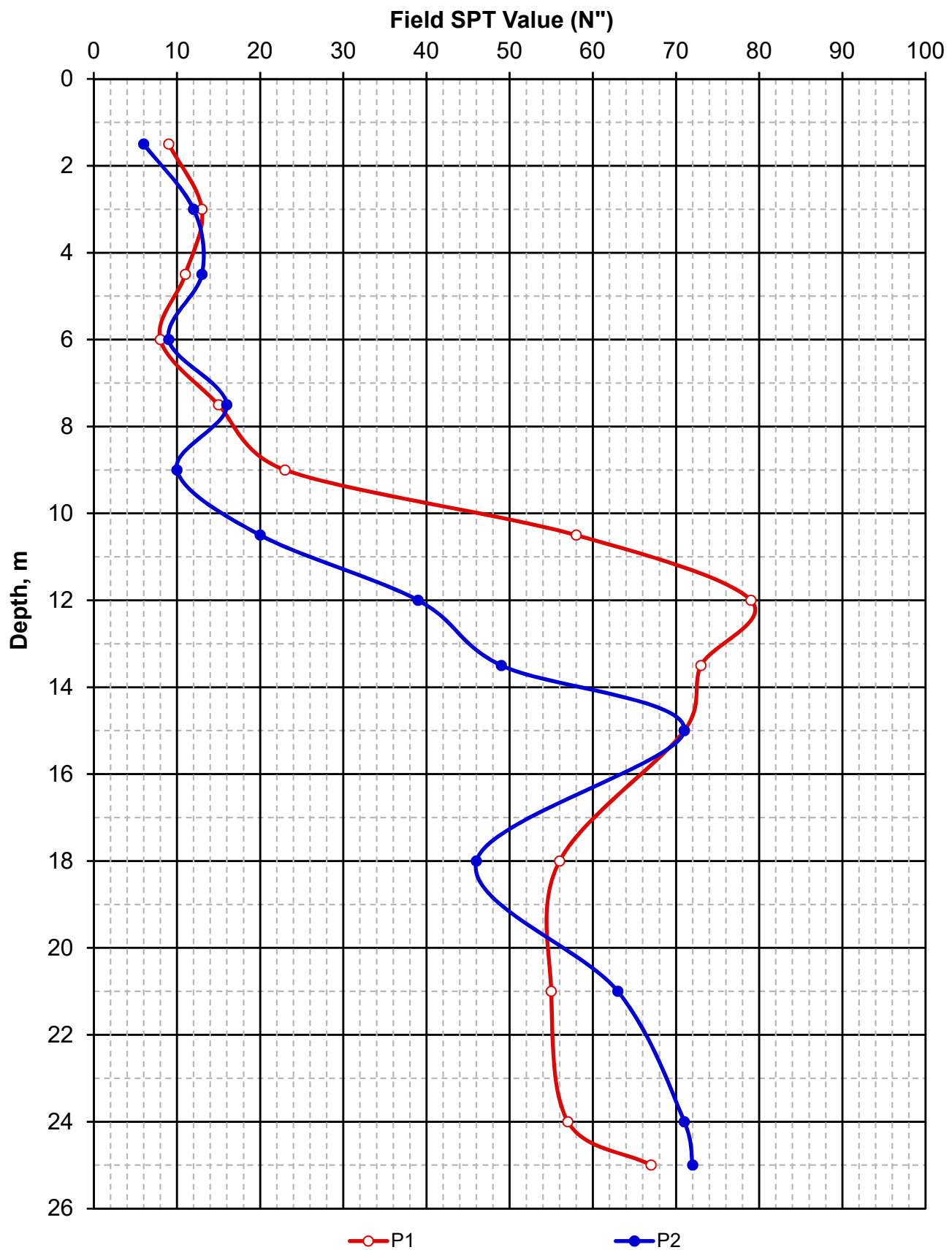
Structure :	66/11kv sub-station, Mitraon	Ground Water Level :	16.4 m
		Termination Depth :	25.45 m

A vertical color calibration bar. The top half features a grayscale ramp with 11 steps, ranging from black to white. The bottom half features a color scale with 11 steps, ranging from yellow to magenta. The word "Scale" is printed vertically to the right of the bar.



LEGEND	
SYMBOL	DESCRIPTION
	GW level
	Fill: Silty sand
	Sandy silt (ML-CL)
	Silty sand (SM)

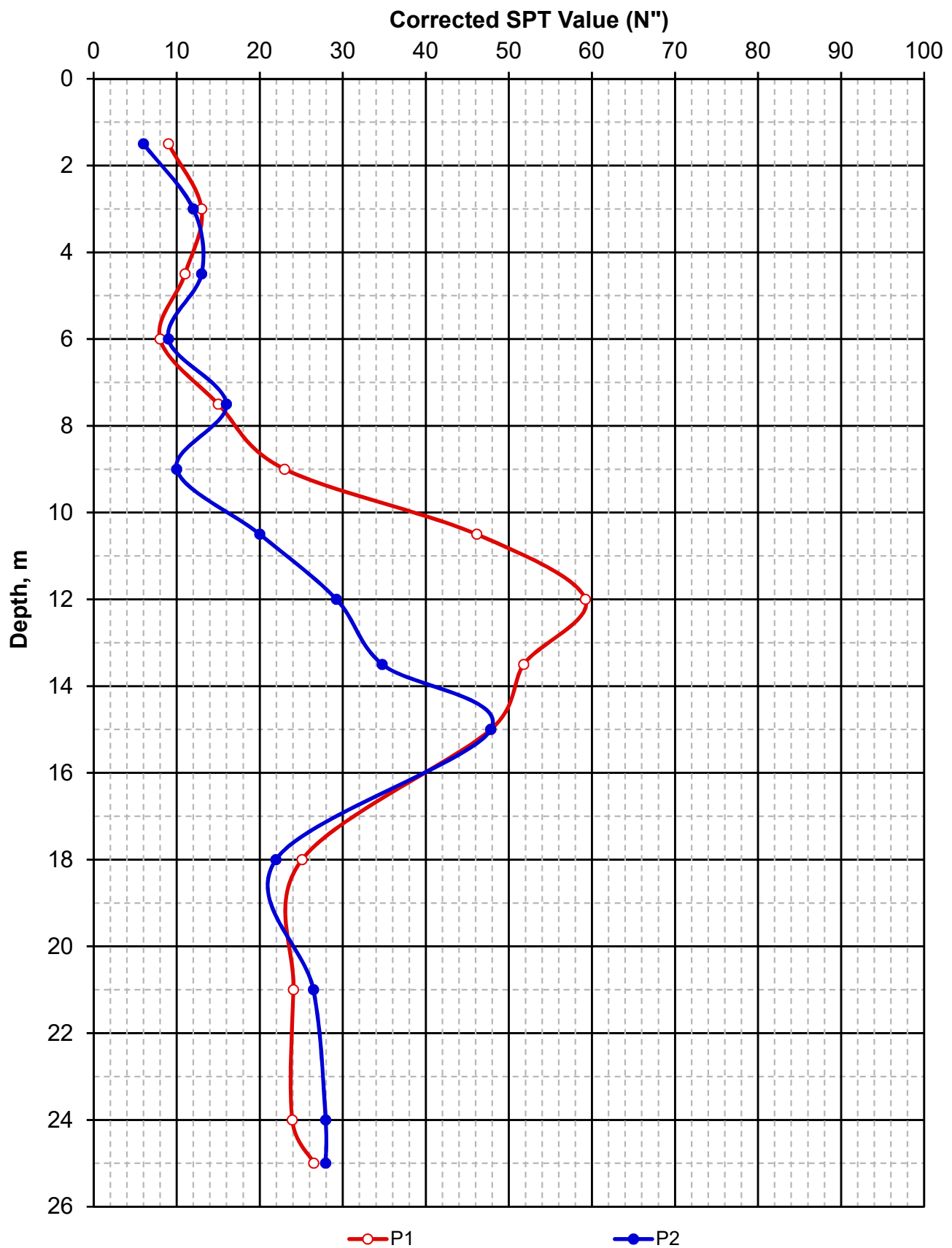
## Cross Section of Boreholes



Location : 66/11 kv Substation, Mitraon.

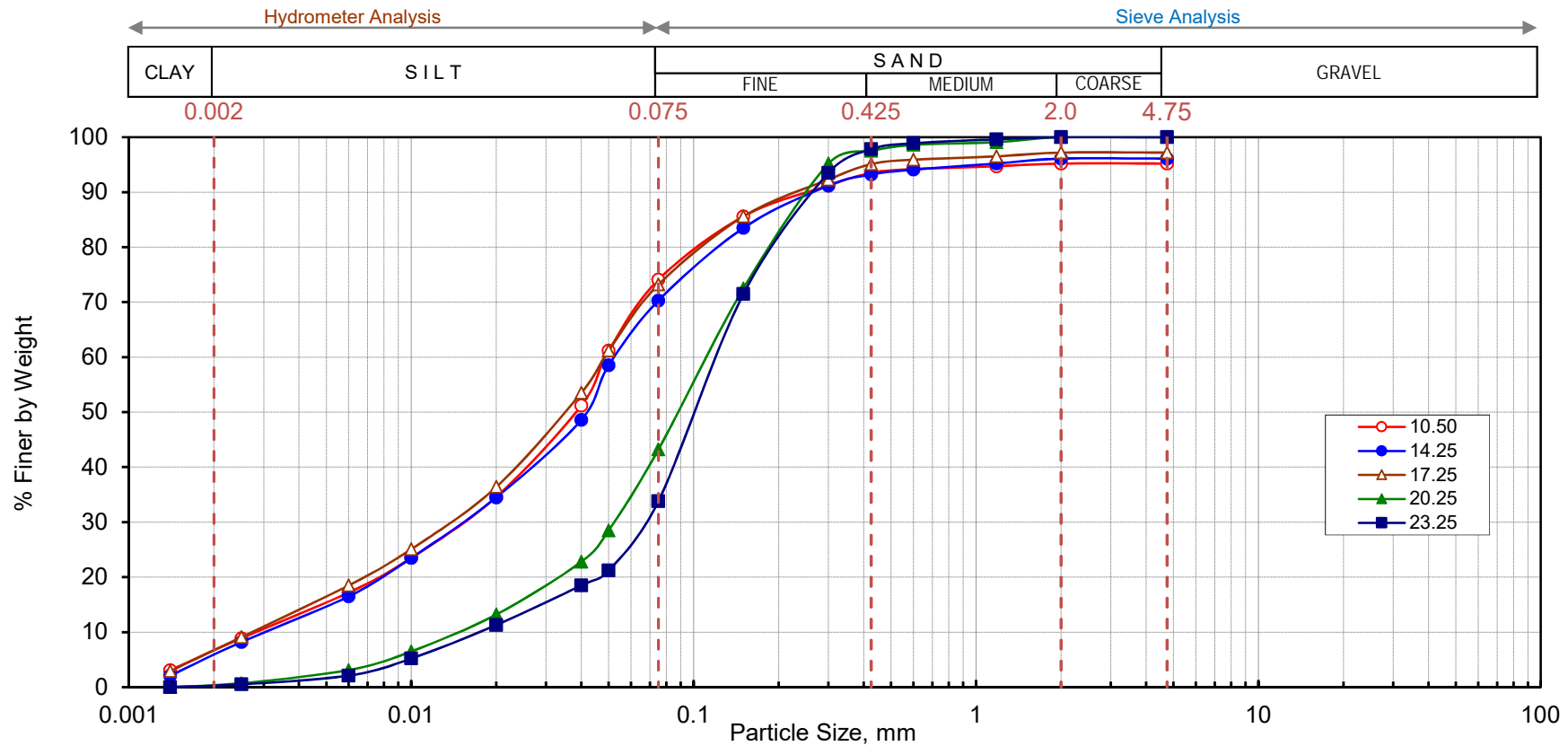
Plot of Field SPT-N value v/s depth





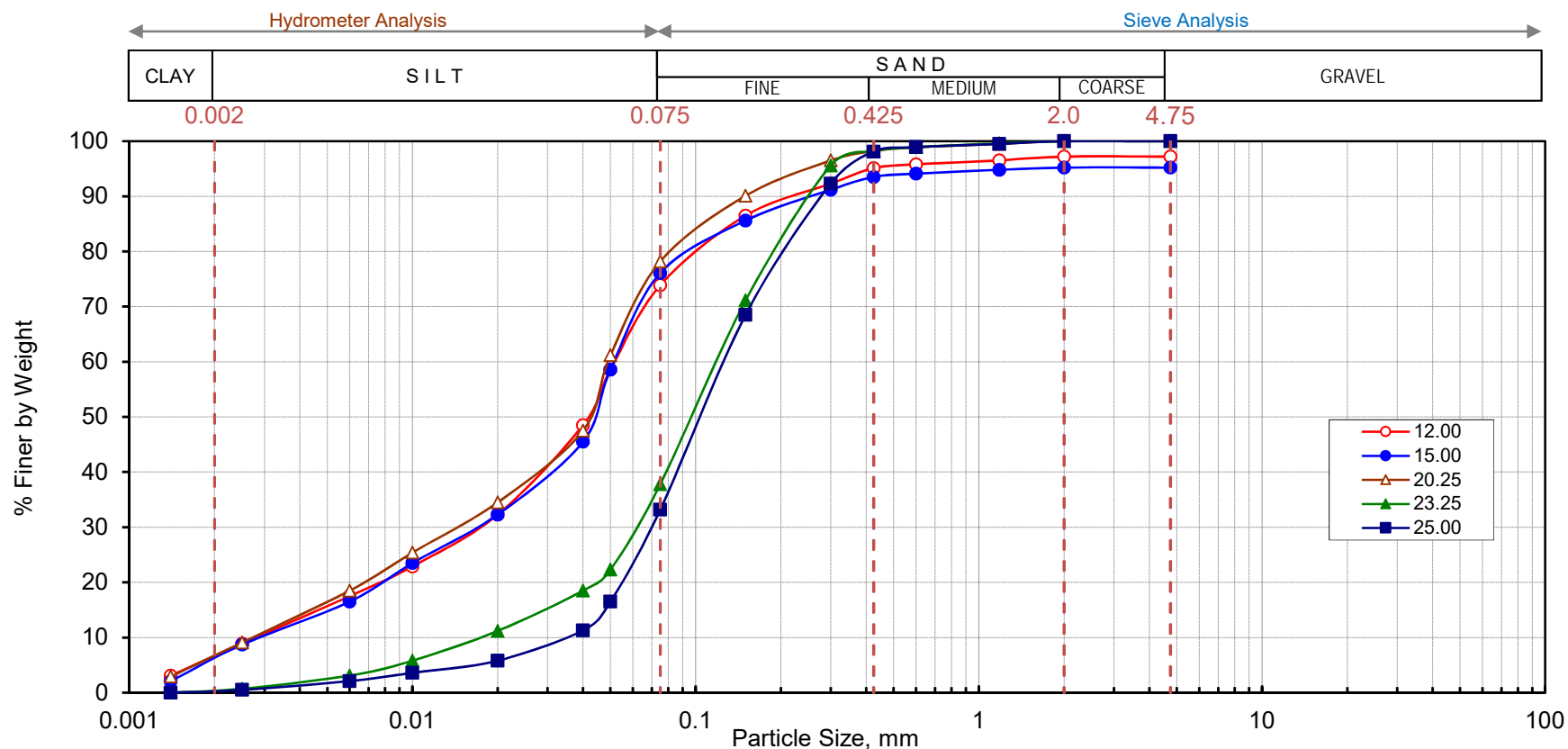
Location : 66/11 kv Substation, Mitraon.

Plot of Corrected SPT-N" value v/s depth



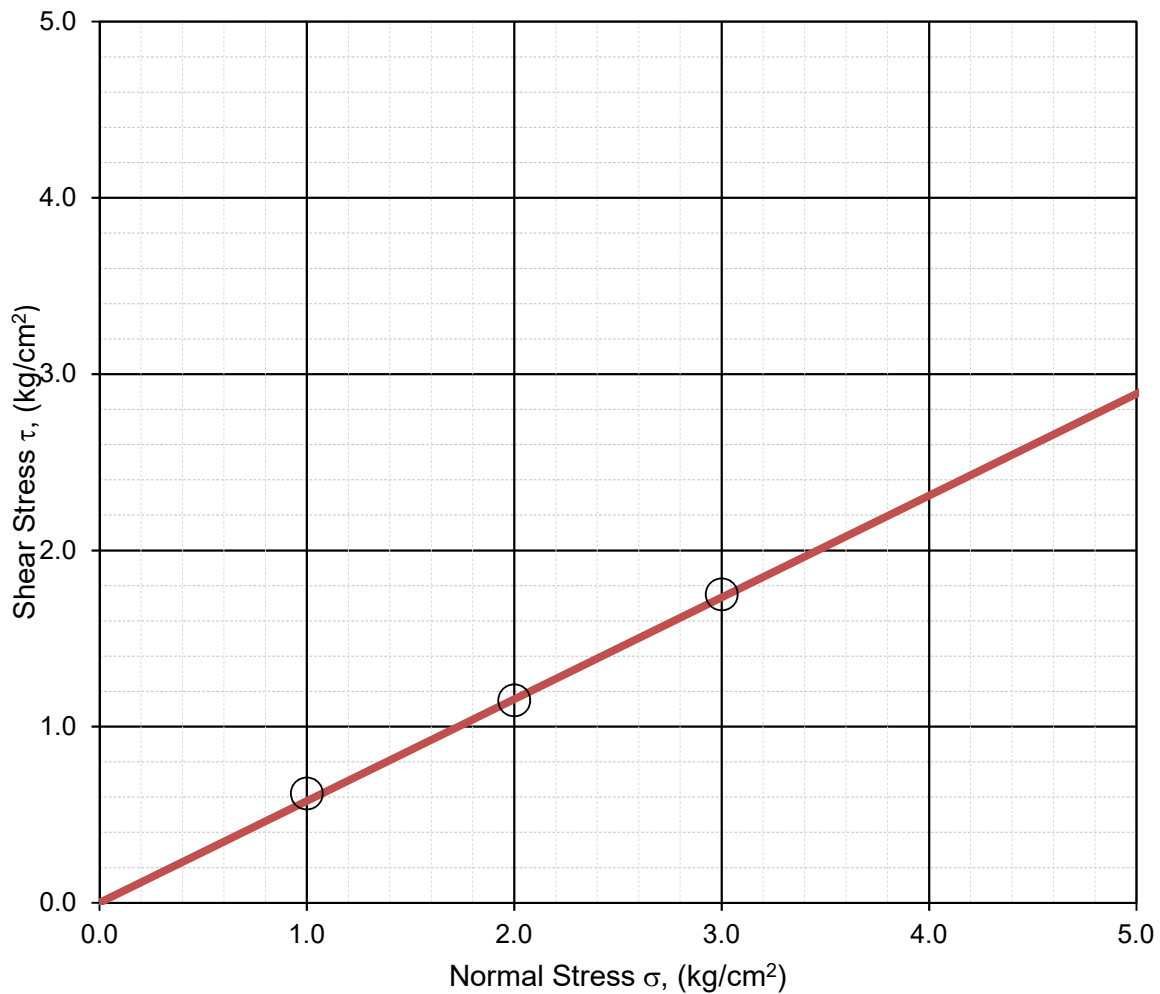
Sample Details				Test Results									
Location	Borehole Number	Sample Depth, m	Sample Description	Gravel %	Sand %	Silt %	Clay %		D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>u</sub>	C <sub>c</sub>
66/11kv sub station, Mitraon.	BH-P1	10.50	Sandy silt (ML-CL)	5	21	68	6		0.049	0.016	0.003	16.5	1.74
	BH-P1	14.25	Sandy silt (ML-CL)	4	26	65	5		0.053	0.016	0.003	16.3	1.46
	BH-P1	17.25	Sandy silt (ML-CL)	3	24	67	6		0.048	0.014	0.003	17.1	1.50
	BH-P1	20.25	Silty sand (SM)	0	57	43	0		0.118	0.053	0.015	7.8	1.54
	BH-P1	23.25	Silty sand (SM)	0	66	34	0		0.127	0.067	0.018	7.1	2.00

### Grain Size Distribution



Sample Details				Test Results									
Location	Borehole Number	Sample Depth, m	Sample Description	Gravel %	Sand %	Silt %	Clay %		D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>u</sub>	C <sub>c</sub>
66/11kv sub station, Mitraon.	BH-P2	12.00	Sandy silt (ML-CL)	3	23	68	6		0.052	0.018	0.003	17.7	2.00
	BH-P2	15.00	Sandy silt (ML-CL)	5	19	70	6		0.052	0.017	0.003	16.9	1.89
	BH-P2	20.25	Sandy silt (ML-CL)	0	22	72	6		0.049	0.015	0.003	17.3	1.63
	BH-P2	23.25	Silty sand (SM)	0	62	38	0		0.125	0.062	0.018	7.0	1.75
	BH-P2	25.00	Silty sand (SM)	0	67	33	0		0.132	0.070	0.035	3.7	1.06

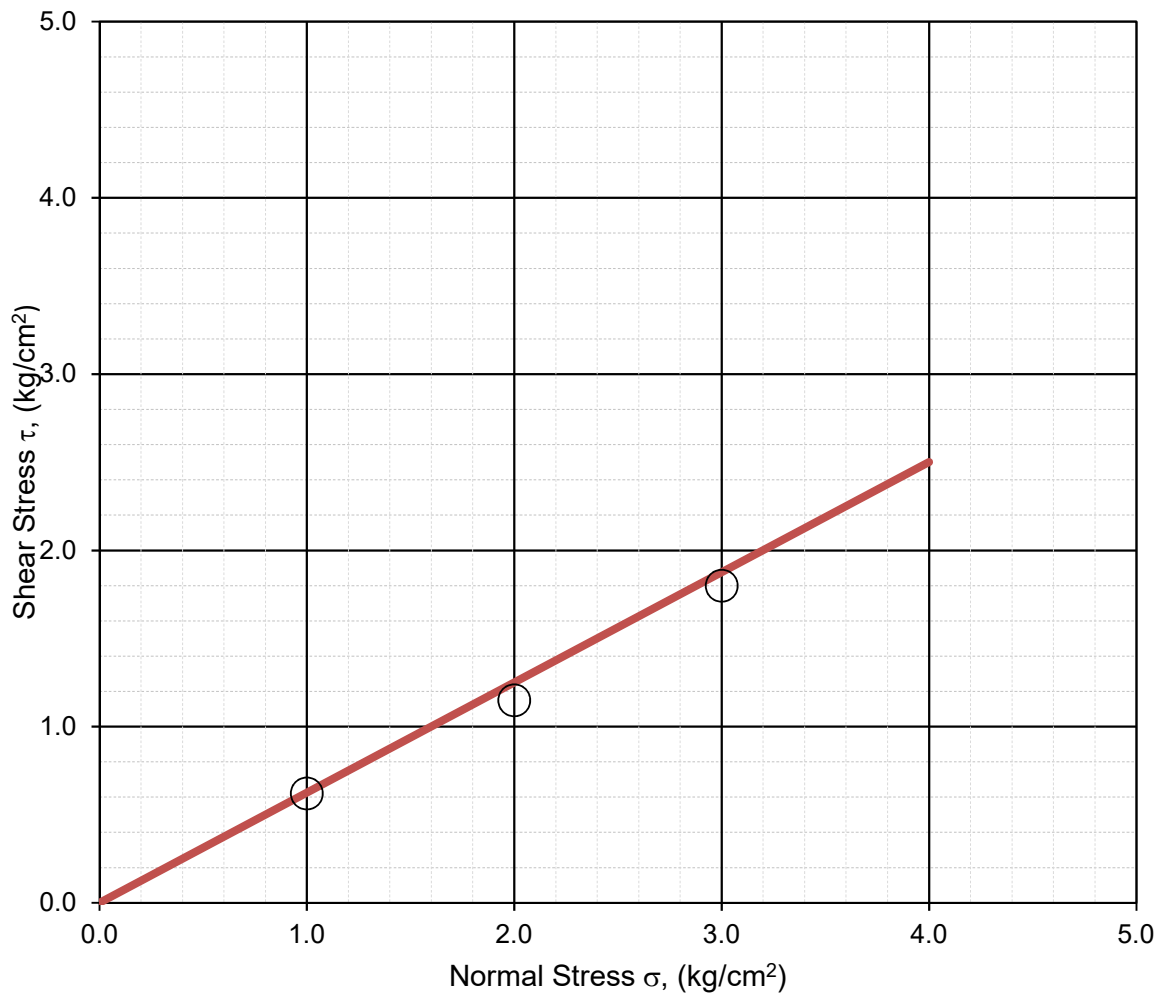
### Grain Size Distribution



Borehole No.	=	P1
Sample Depth, m	=	11.25
Sample Description	=	Sandy silt

<b>Cohesion Intercept, <math>c</math> (kg/cm<sup>2</sup>)</b>	<b>=</b>	<b>0</b>
<b>Angle of Internal Friction, <math>\phi</math> (degrees)</b>	<b>=</b>	<b>30</b>

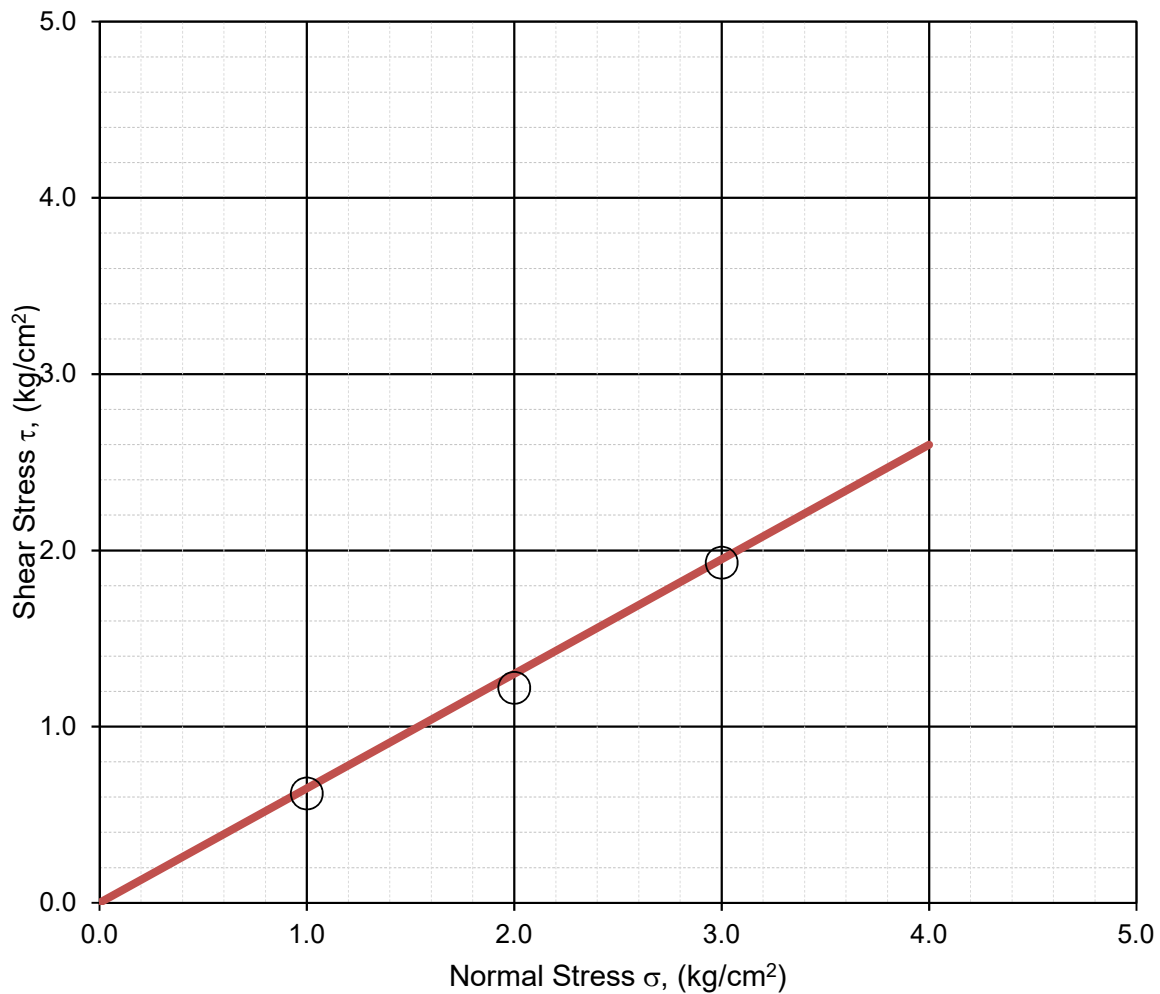
### Consolidated Drained Direct Shear Test



Borehole No.	=	P1
Sample Depth, m	=	20.25
Sample Description	=	Silty sand

<b>Cohesion Intercept, <math>c</math> (kg/cm<sup>2</sup>)</b>	<b>=</b>	<b>0</b>
<b>Angle of Internal Friction, <math>\phi</math> (degrees)</b>	<b>=</b>	<b>32</b>

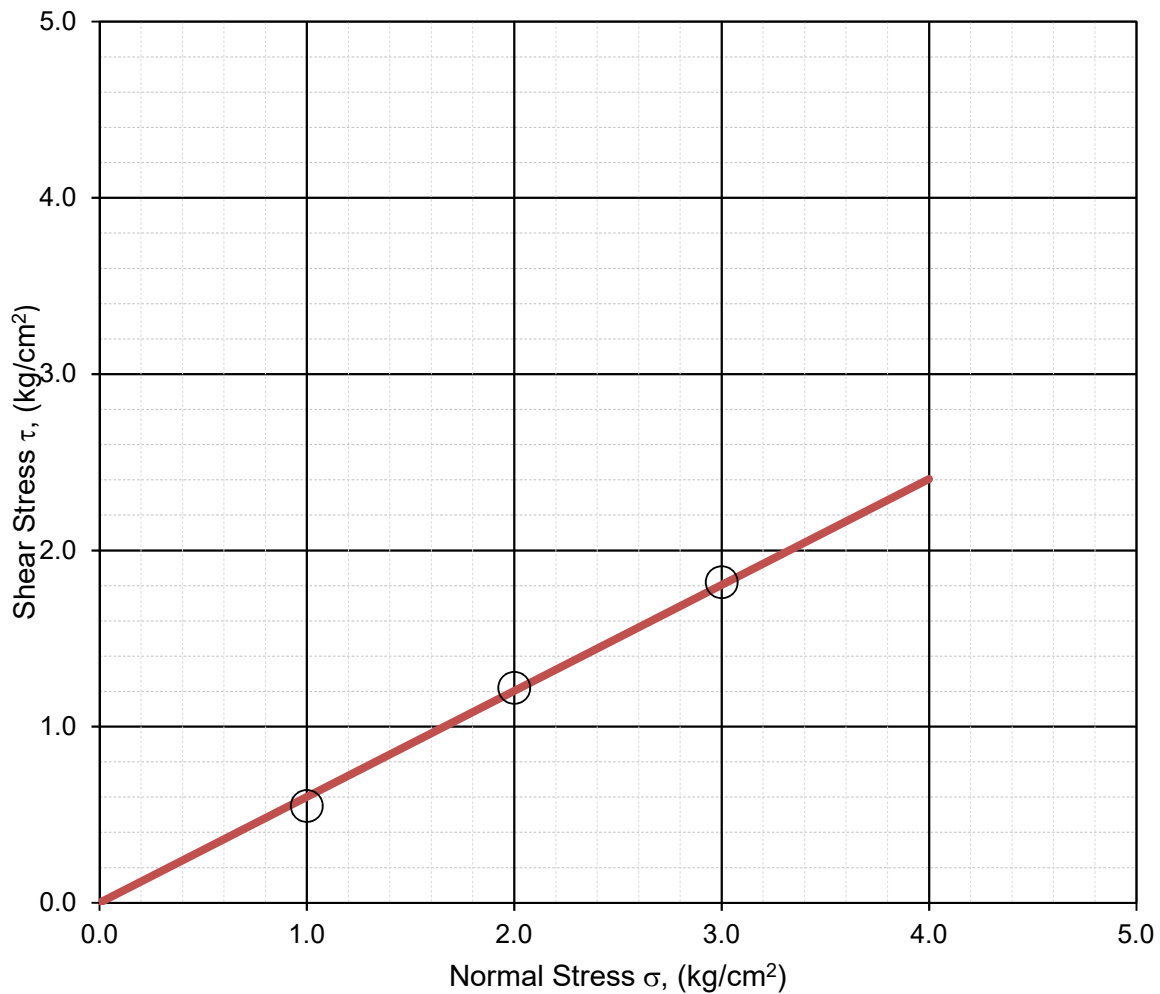
### Consolidated Drained Direct Shear Test



Borehole No.	=	P1
Sample Depth, m	=	23.25
Sample Description	=	Silty sand

<b>Cohesion Intercept, <math>c</math> (kg/cm<sup>2</sup>)</b>	<b>=</b>	<b>0</b>
<b>Angle of Internal Friction, <math>\phi</math> (degrees)</b>	<b>=</b>	<b>33</b>

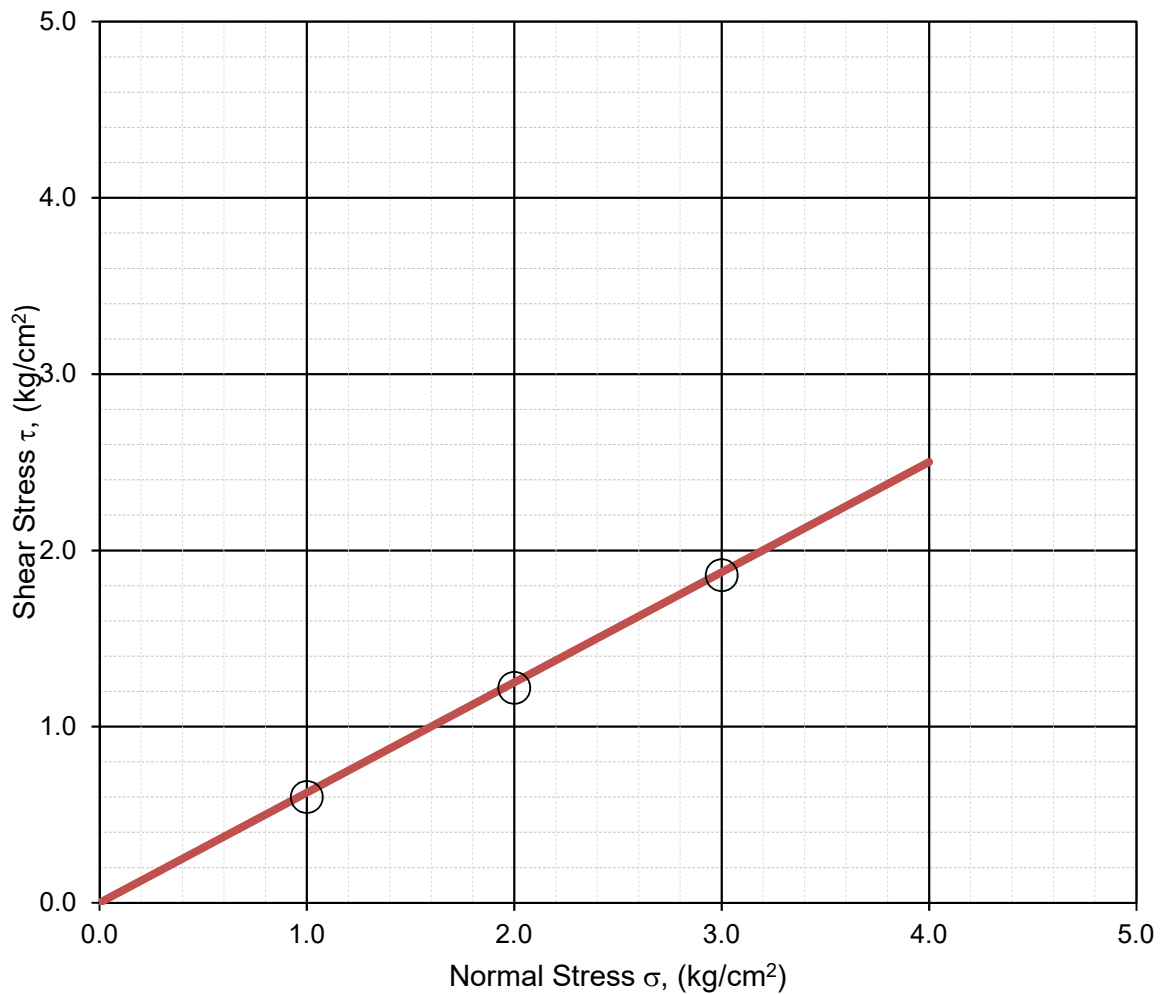
### Consolidated Drained Direct Shear Test



Borehole No.	=	P2
Sample Depth, m	=	14.25
Sample Description	=	Sandy silt

<b>Cohesion Intercept, <math>c</math> (kg/cm<sup>2</sup>)</b>	<b>=</b>	<b>0</b>
<b>Angle of Internal Friction, <math>\phi</math> (degrees)</b>	<b>=</b>	<b>31</b>

### Consolidated Drained Direct Shear Test



Borehole No.	=	P2
Sample Depth, m	=	23.25
Sample Description	=	Silty sand

Cohesion Intercept, $c$ (kg/cm <sup>2</sup> )	=	0
Angle of Internal Friction, $\phi$ (degrees)	=	32

### Consolidated Drained Direct Shear Test





## CHEMICAL TEST RESULTS

### SOIL-EXTRACT WATER:

Borehole No.	Depth, m	Sulphate Content (SO <sub>3</sub> ), %	Chloride Content (CL), %	pH Value
P1	2.25	0.15	0.02	7.3
P2	4.50	0.13	0.05	7.6

### GROUNDWATER:

Borehole No.	Depth, m	Sulphate Content (SO <sub>3</sub> ), %	Chloride Content (CL), %	pH Value
P1	-	312	181	7.2
P2	-	290	212	7.5



## Computation of Safe Pile Capacities

By Static Analysis (Analysis in accordance with Part 1 / Section 2) : 2010)

**Mitraon (Boreholes : BH-P1 & P2)**  
**500 mm dia. Piles**

Pile Type : **Bored Cast in Situ**      RCC Pile

### INPUT PARAMETERS

Location : <b>Mitraon</b>	Grade of Concrete : M <b>30</b>
Boreholes : <b>BH-P1 &amp; P2</b>	Soil Classification: <b>Cohesive</b>
Design Water Table Depth : <b>12.0</b> m	Normally Consolidated or Preconsolidated Clays? <b>P</b>
Pile Cross section : <b>Circle</b>	Unconfined Compression Strength (qu) = <b>150</b>
Pile Diameter ,D : <b>500</b> mm	Saturation : <b>Submerged</b>
Pile cut-off Level (COL) : <b>1.0</b> m	Pile Head : <b>Fixed</b>
Overburden Pressure to be considered below <b>GL</b>	Free Standing Length of Pile or Length of pile below cut-off-level not contributing substantially to lateral capacity (e) : <b>0.0</b> m
Consider overburden pressure to become constant below <b>15</b> pile diameters, i.e. <b>7.5</b> m below <b>0.0</b> m	
	i.e. <b>7.5</b> m below <b>0.0</b> m
Factor of Safety : <b>2.5</b> as per IS Code Specifications	

### DESIGN PROFILE

Depth		Soil Classification	C , kN/m <sup>2</sup>	$\phi$ , degrees	$\gamma$ , kN/m <sup>3</sup>
From	To				
<b>0</b>	<b>12</b>	<b>Fill</b>	<b>0</b>	<b>0</b>	<b>16.5</b>
<b>12</b>	<b>21</b>	<b>Sandy silt</b>	<b>0</b>	<b>30</b>	<b>17.5</b>
<b>21</b>	<b>25</b>	<b>Silty sand</b>	<b>0</b>	<b>31</b>	<b>18.5</b>

Pile Capacity Calculation at following	<b>15.0</b>	<b>17.0</b>	<b>19.0</b>		
Pile Length(s) below cut-off Level (m)					

### COMPUTED SAFE PILE CAPACITIES

Depth Below GL, m	Pile Length below COL, m	Safe Pile Compression Capacity, MT	Safe Pullout Capacity, MT	Lateral Pile Capacity, MT
<b>16.0</b>	<b>15.0</b>	<b>33</b>	<b>17</b>	<b>8.8</b>
<b>18.0</b>	<b>17.0</b>	<b>42</b>	<b>23</b>	
<b>20.0</b>	<b>19.0</b>	<b>50</b>	<b>29</b>	

### By Static Analysis

### Mitraon (Boreholes : BH-P1 & P2)

Pile Type : **Bored Cast in Situ** RCC Pile

Loading :            Axial Compression

$$Q_{\text{safe}} = (1/FS) \{ \sum_{1 \text{ to } n} [(\alpha c + p k \tan \delta) A_s L] + [(c N_c + p N_q + 0.5 D \gamma' N_\gamma) A_p] \}$$

$Q_{\text{safe}}$	=	Safe axial pile capacity, kN	FS	=	Factor of safety
$\alpha$	=	Adhesion factor ( <i>function of <math>C_u</math></i> )	p	=	Overburden pressure, kN/m <sup>2</sup>
$\delta$	=	Angle of wall friction between soil and pile, degrees	L	=	Pile segment length in selected layer
c	=	Cohesion intercept, kN/m <sup>2</sup>	k	=	Coefficient of earth pressure
$\gamma'$	=	Effective density of soil, kN/m <sup>3</sup>	D	=	Pile diameter
$N_c, N_q, N_\gamma$	=	Bearing capacity factors, which are a function of $\phi$	$A_s$	=	Pile surface area per m length
n	=	Number of layers	$A_p$	=	Pile end bearing area

Pile cut-off Level (COL) :	1.0	m
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Pile Surface Area,  $A_s = 1.571 \text{ m}^2/\text{m length}$

Pile cross-section Area,  $A_p = 0.196 \text{ m}^2$

Consider overburden pressure to 15 pile diameters, i.e. 7.5 m below 1.0 m

become constant below : i.e. 8.5 m below 0.0 m

Factor of Safety : 2.5 as per IS 2911 (Part 1 / Section 2) : 2010

Pile Capacity Calculation at following Pile Length(s) below cut-off Level (m)	15.0	17.0	19.0		



## Computation of Safe Axial Compressive Pile Capacity

By Static Analysis

Analysis in accordance with IS 2911 (Part 1 / Section 2) : 2010

**Mitraon (Boreholes : BH-P1 & P2)**

**500 mm dia. Piles**

Pile Type : **Bored Cast in Situ** RCC Pile

Loading :

Axial Compression

Pile Dia = 500 mm

Depth Below GL , m	Pile Length below COL, m	Layer No.	Soil Parameters			Overburden Pressure  <i>kN/m<sup>2</sup></i>	Unit Skin Friction  <i>kN/m<sup>2</sup></i>	Skin Friction in Layer  <i>kN</i>	Cumulative Skin Friction  <i>kN</i>	Unit End Bearing  <i>kN/m<sup>2</sup></i>	Total End Bearing  <i>kN</i>	Ult. Pile Capacity  <i>kN</i>	Weight of Pile  <i>kN</i>	Safe Pile Capacity  <i>kN</i>	Safe Pile Capacity  <i>MT</i>
			<i>c</i> , <i>kN/m<sup>2</sup></i>	$\phi$ ( $=\delta$ ), degrees	$\gamma_{eff}$ , <i>kN/m<sup>3</sup></i>										
0.0		1	0.0	0											
1.0	<b>0.0</b>	1	0.0	0	16.5	0.0	0	0	0						
8.5	<b>7.5</b>	1	0.0	0	16.5	61.9	0	0	0						
12.0	<b>11.0</b>	1	0.0	0	16.5	123.8	0	0	0						
		2	0.0	30	7.5	123.8	71	112	112						
13.0	<b>12.0</b>	2	0.0	30	7.5	123.8	71	337	449	2634	517	966	63	<b>324</b>	<b>33</b>
16.0	<b>15.0</b>	2	0.0	30	7.5	123.8	71	224	673	2634	517	1191	68	<b>408</b>	<b>42</b>
18.0	<b>17.0</b>	2	0.0	30	7.5	123.8	71	224	898	2634	517	1415	74	<b>492</b>	<b>50</b>
20.0	<b>19.0</b>					123.8									



## Computation of Safe Axial Pullout Capacity of Pile

By Static Analysis

Analysis in accordance with IS 2911 (Part 1 / Section 2) : 2010

**Mitraon (Boreholes : BH-P1 & P2)**  
**500 mm dia. Piles**

Pile Type : **Bored Cast in Situ RCC Pile**

Loading : Axial Pullout (Uplift)

The safe uplift capacity of pile is calculated as :

$$Q_{\text{safe}} = (1/FS) \{ \sum_{1 \text{ to } n} [(\alpha c + p k \tan \delta) A_s L] \} + W$$

where

$Q_{\text{safe}}$	=	Safe axial pile capacity, kN	FS	=	Factor of safety
$\alpha$	=	Adhesion factor ( <i>function of <math>C_u</math></i> )	p	=	Overburden pressure, kN/m <sup>2</sup>
$\delta$	=	Friction angle between soil and pile, degrees (= $\phi$ )	L	=	Pile segment length in selected layer
c	=	Cohesion intercept, kN/m <sup>2</sup>	k	=	Coefficient of earth pressure
$\gamma'$	=	Effective density of soil, kN/m <sup>3</sup>	D	=	Pile diameter
n	=	Number of layers	$A_s$	=	Pile surface area per m length
W	=	Weight of the pile			

Pile cross section shape : **Circle**

Pile cut-off Level (COL) : **1.0 m**

Pile Diameter, D : **500 mm**

Pile Surface Area,  $A_s$  = **1.571 m<sup>2</sup>/m length**

Overburden Pressure to be considered below : **COL**

Consider overburden press. to

become constant below : **15** pile diameters, i.e. **7.5 m** below **1.0 m**  
i.e. **8.5 m** below **0.0 m**

Design Water Table Depth : **12.0 m**

Factor of Safety : **3.0** as per IS 2911 (Part 1 / Section 2) : 2010 Clause 6.3.2

Percentage of Ultimate Shaft Resistance to be used for Ultimate Pullout Capacity: **0.7**

Layer No.	Depth, m		Soil Classification	$c$ , kN/m <sup>2</sup>	$\delta$ (= $\phi$ ), degrees	$\gamma$ , kN/m <sup>3</sup>	k	$\alpha$
	From	To						
1	0.0	12.0	Fill	0	0	17	1.0	
2	12	21.0	Sandy silt	0	30	18	1.0	
3	21.0	25.0	Silty sand	0	31	19	1.1	

Pile Capacity Calculation at following	<b>15.0</b>	<b>17.0</b>	<b>19.0</b>		
Pile Length(s) below cut-off Level (m)					

### By Static Analysis

**Mitraon (Boreholes : BH-P1 & P2)  
500 mm dia. Piles**

[illegible]



## Lateral Load Carrying Capacity for Pile Foundations

Analysis in accordance with: IS: 2911 Part 1 Section 2 - 2010

### Mitraon (Boreholes : BH-P1 & P2)

#### 500 mm dia. Piles

Pile Type : Bored Cast in Situ RCC Pile  
 Pile cross-section : Circle  
 Pile Dia : 500 mm  
 Pile Cut-off-Level below GL 1.0 m Pile Length : 16 m  
 Pile Head : Fixed Head Condition  
 Grade of Concrete : M 30 Modulus of Elasticity : 27386 MPa  
 Moment of Inertia, I : 3.068E-03 m<sup>4</sup>  
 Soil Classification: Cohesive Normally Consolidated or Preconsolidated Clays? P  
 Unconfined Compression Strength (qu) = 150.0 kPa  
 Saturation : Submerged

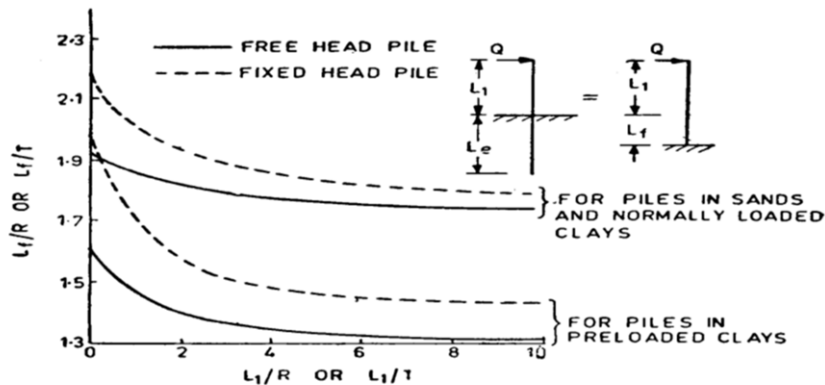


FIG. 2 DETERMINATION OF DEPTH FIXITY

$$T = (EI/\eta_n)^{1/5} \text{ for Granular Soils and NC Clays} \quad R = (EI/KB)^{1/4} \text{ for Preconsolidated Clays}$$

$$\text{Modulus of Subgrade Reaction, } k_1 = 27.0 \text{ MN/m}^3 \quad R = 1.99 \text{ m}$$

Free Standing Length of Pile or Length of pile below cut-off-level not contributing substantially to lateral capacity (e) : 0.0 m

$$e/R = 0.0 \quad \text{Reading off from graph, } zf/R = 1.95$$

$$\text{Depth of Fixity, } z_f = 3.87 \text{ m} \quad e + z_f = 3.87 \text{ m}$$

$$\text{Deflection, } y = \frac{H(e + z_f)^3}{3EI} \times 10^3 \quad \dots \text{ for free-head pile}$$

$$\text{Deflection, } y = \frac{H(e + z_f)^3}{12EI} \times 10^3 \quad \dots \text{ for fixed-head pile}$$

where : y = Lateral deflection at pile top

e = Free-standing length of pile

H = Lateral load applied

z<sub>f</sub> = Depth of fixity

$$\text{Permissible Horizontal Deflection at top of pile, } Y = 5.0 \text{ mm}$$

$$\text{Computed Lateral Capacity of Pile, } H = 87 \text{ kN} = 8.8 \text{ Tonnes}$$