(Corporate Contracts Department)
The Tata Power Company Limited, 2nd Floor, Sahar Receiving Station
Sahar Airport Road, Andheri East, Mumbai-400059

The Tata Power Company Limited Invites Tenders through E-Tender (Two-Part Bidding Process) from eligible and interested bidders for the following packages: -

A. Summary of the tendered packages:

Sr. No.	Description	Tender Reference no.	Bid Guarantee Fee / EMD (₹)	Tender Fee (₹)	Last date and time for Payment of Tender Participation Fee
1.	Protection, Automation, communication system for 3 bays at Kolshet	CC21AK009	500,000	1,000	29th May 2021; 15:00 Hrs

B. Procedure for Participation

Interested bidders to submit Tender Participation Fee and Authorization Letter before Last date and time as indicated above, after which detailed RFQ shall be shared through Tata Power e-Tender system (Ariba):

1. Non-Refundable Tender Participation Fee, as indicated in table above, to be submitted in the form of-

   Direct deposit in the following bank account and submit the receipt along with a covering letter clearly indicating the Tender Reference number –

   Beneficiary Name – The Tata Power Co. Ltd.

   Bank Name – HDFC Bank Ltd.

   Branch Name – Fort Branch, Mumbai

   Address – Maneckji Wadia Building, Nanik Motwani Marg, Fort, Mumbai 400023.

   Branch Code – 60

   Bank & Branch Code – 400240015

   Account No – 00600110000763

   Account type – CC

   IFSC Code – HDFC0000060

2. Bidders to submit duly signed and stamped letter on Bidder's letterhead indicating
    a. Tender Enquiry number
    b. Name of authorized person
    c. Contact number
    d. e-mail id
    e. Details of submission of Tender Participation Fee

Package Owner- Mr. Abrar Khan (abrarkhan@tatapower.com)

Please share above documents/details with package owner, with copy to Mr. P N Ramesh Kumar (pnramesh@tatapower.com), before Last date for Payment of Tender Participation Fee.

Please note all future correspondence regarding the tender, bid submission, bid submission date extension, Pre-bid query etc will be only through Tata Power e-Tender system (Ariba). User manual to guide the bidders to submit the bid through e-Tender system (Ariba) is also enclosed.

No e-mail or verbal correspondence will be responded. All communication will be done strictly with the bidder who have complied with above steps to participate in the Tender.

Also it may be strictly noted that once date of “Last date and time for Payment of Tender Participation Fee” is lapsed no Bidder will be sent link from Tata Power e-Tender System (Ariba). Without this link vendor will not be able to participate in the tender. Any last moment request to participate in tender will not be entertained.

Any payment of Tender Participation Fee / EMD by Bidder who have not done the pre-requisite within stipulated timeline will not be refunded

TATA POWER

Tender Documents

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OPEN TENDER NOTIFICATION

FOR

Protection, Automation and Communication System for 03 Bays at Kolshet Receiving Station.

Tender Enquiry No.: CC21AK009

Due Date for Bid Submission: 16th June 2021 [15:00 Hrs.]

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The Tata Power Company Limited

Mumbai, Maharashtra

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CONTENTS OF THE ENQUIRY

Following Documents Form Part of Tender Enquiry:

Section no	Description
A	**Tender Document**
	Event Information
	Evaluation Criteria
	Submission of Bid Documents
	Bid Opening & Evaluation process
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	Annexure I – Schedule of Items
	Annexure II – Pre-Qualification Requirement
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	Annexure V – Checklist of documents to be submitted with Bid
B	**Technical Specifications/work Scope & SLA**
C	**GCC, SCC ,Format for Bank Guarantees ,CSM**
D	**Tata Power Standard Policies- Health and Safety Policy, Environment Policy, sustainability Policy**

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Section A : Tender Document

1. Event Information

1.1 Scope of Work

Open Tenders are invited through e-Tender (Two-Part Bidding Process) from eligible and interested bidders for the following package, required for Mumbai Transmission: -

Sr. No.	Description	Tender Reference no.	Bid Guarantee Fee / EMD (₹)	Tender Fee (₹)	Last date and time for Payment of Tender Participation Fee
1.	Protection, Automation and Communication system for 3 bays at kolshet	CC21AK009	5,00,000	1,000	29th May 2021; 15:00 Hrs

1.2 Calendar of Events

(a)	Date by which Interested and Eligible Bidder to pay Tender Fee and confirm Participation	**29th May 2021; 15:00 Hours**
(b)	Last Date of receipt of pre-bid queries, if any. (in editable QCD Format-Annexure-III)	**5th June 2021; 15:00 Hours***
(c)	Date of Posting Consolidated replies to all the pre-bid queries as received	**9th June 2021***
(d)	Last date and time of receipt of Bids	**16th June 2021; 15:00 Hours***

Note:- * These date and time are as planned and tentative. In case of change the same shall be intimated to Authorized Person of Interested Bidder through E-Tender System.

Please note post submission of Bids relevant communication will be done with Authorized Person of Interested Bidder through E-Tender System

1.3 Mandatory documents required along with the Bid

1.3.1 Bid Guarantee Fee (EMD) of requisite value and validity. PLEASE NOTE THAT BID GUARANTEE ONLY IN FORM OF BANK GUARANTEE WILL BE ACCEPTED in given format.

1.3.2 Requisite Documents to ascertain fulfilling of Technical and Commercial Pre-Qualification Requirement as detailed in Tender Enquiry.

1.3.3 Technical Submission including Drawings, Type Test details etc as detailed in Technical Specification.

1.3.4 Required Commercial Submission as detailed in Tender Document

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1.3.5 Technical and Commercial Clarification and Deviations as per the format attached in the Tender Enquiry

1.3.6 Proper authorization letter to sign the tender and participate in Tata Power E-Tender system on the behalf of bidder.

Please note that in absence of any of the above documents, the bid submitted by a bidder shall be liable for rejection.

Also please note that whenever editable format are shared it is requested that data be filled in relevant cells. No formatting or addition / deletion of rows / columns to be done. Wherever editable Excel submission are requested the file should be free from references, macros etc.

1.4 Deviation from Tender

Normally, the deviations to tender terms are not admissible and the bids with deviation are liable for rejection. Hence, the bidders are advised to refrain from taking any deviations on this Tender. Still in case of any deviations, all such deviations shall be set out by the Bidders, clause by clause in the '**Annexure III** – Query/clarification/Deviation Format' and same shall be submitted as a part of the Technical Bid.

1.5 Right of Acceptance/Rejection

1.5.1 Bids are liable for rejection in absence of following:-
1.5.2 Mandatory Documents as listed in 1.3 above
1.5.3 Price Bid as per the Price Schedule mentioned in Tender Document
1.5.4 Receipt of Bid and Response to queries within the due date and time
Tata Power reserves the right to accept/reject any or all the bids without assigning any reason thereof.

1.6 Qualification Criteria

Technical Qualification- As per attached Technical specification

Commercial Qualification-

- Average Annual turnover of the bidder for last three years shall not be less **than Rs 4.0 Crores**. Bidder to submit Profit and Loss Statements, Balance Sheet Statements for the Three (3) preceding financial years duly audited and approved by Authorized Audit Firm / CA
- In case the package involves installation & commissioning of the equipment / material, then the bidder shall have the following experience:
- a) He should have successfully completed one single order of value Rs 2.2 Cr of similar work in last three years) OR

  b) He should have successfully completed two single orders of value Rs 1.3 Cr of similar work in last three years) OR

  c) He should have successfully completed three single orders of value Rs 1.1 Cr value of similar work in last three years).

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1.7 Pre-Bid Queries

Pre-Bid Queries if any has to be sent through message in E-Tender System. Pre-Bid Query has to be sent only in the Query / Clarification / Deviation (QCD) Format. Technical Pre-Bid Query and Commercial Pre-Bid Query have to be submitted in Separate Editable Excel File in Prescribed Format. Pre-Bid Queries sent in any other format or send through any other communication channel will not be accepted and answered. Pre-Bid Query have to be sent in the stipulated timeline as defined in the Tender Document. No Pre-Bid Query will be accepted after the due time and date as specified as "Last Date of receipt of pre-bid queries, if any"

1.8 Marketing Integrity

We have a fair and competitive marketplace. The rules for bidders are outlined in the General Condition of Contracts and other parts of Tender Documents. Bidders must agree to these rules prior to participating. In addition to other remedies available, Tata Power 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 General Condition of Contracts or other part of the Tender Documents. A bidder who violates the marketplace rules or engages in behavior that disrupts the fair execution of the marketplace, may result in restriction of a bidder from further participation in the marketplace 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 terms as published in TENDER
- Submit irrelevant documents or frequently cases of missing documents as part of compliance to Qualifying, Technical or Commercial Requirements causing unnecessary delay in Tender Evaluation

1.9 Supplier Confidentiality

All information contained in this tender is confidential and shall not be disclosed, published or advertised in any manner without written authorization from Tata Power. This includes all bidding information submitted to Tata Power. All tender documents remain the property of Tata Power and all suppliers are required to return these documents to Tata Power upon request. Suppliers who do not honor these confidentiality provisions will be excluded from participating in future bidding events.

2. Evaluation Criteria

- The bids will be evaluated technically on the compliance to tender terms and conditions.
- The bids will be evaluated commercially on the overall all-inclusive lowest cost as calculated in Schedule of Items (Annexure-I). Tata Power however, reserves right to split the order line item wise and/or quantity wise among more than one Bidder. Hence all bidders are advised to quote their most competitive rates against each line item.
- Bidder has to mandatorily quote against each item of, Schedule of Items (Annexure-I). Failing to do so, Tata Power may reject the bids.

NOTE: In case of a new bidder not registered with Tata Power, factory inspection and evaluation shall be carried out to ascertain bidder's manufacturing capability and quality procedures. However Tata Power reserves the right to carry out factory inspection and evaluation for any bidder prior to technical

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qualification. In case a bidder is found as Disqualified in the factory evaluation, their bid shall not be evaluated any further and shall be summarily rejected. The decision of Tata Power shall be final and binding on the bidder in this regard.

Price Variation Clause:

The prices shall remain firm during the entire contract period.

3. Submission of Bid Documents

3.1 Bid Submission

Bidders are requested to submit their offer in line with this Tender document. Bids shall be submitted in 3 (three) parts:

FIRST PART: "EMD – BANK GUARANTEE" of Value detailed in 1.1 valid for 180 days from the due date of bid submission in the form of Bank Guarantee favoring 'The Tata Power Company Limited'. The EMD has to be strictly in the format as mentioned in Tender Document, failing which it shall not be accepted by Tata Power and the bid as submitted shall be liable for rejection.

Note : BG of 180 days and further claim period of 180 days is needed. In case the same cannot be issued by your bank then BG valid for 365 days can be provided.

Note : At times bidders have sought Tata Power bank details which is needed by them to make BG. Hence the same is reproduced below. These details are only provided to facilitate making of BG if needed

Tata Power's Bank Details for submitting EMD BG:
Bank Name & Address – ICICI Bank, 163 HT Marg,
Backbay Reclamation, Churchgate, Mumbai 400 020.
A/c no. - 000451000293
IFSC Code – ICIC0000393

The hard copy of EMD in a sealed envelope should be sent on address mentioned in Tender document.

First Part has to be submitted in Sealed Envelope.

SECOND PART: "TECHNICAL / UN-PRICED COMMERCIAL BID" shall contain the following documents:

a) Documentary evidence in support of Technical, Commercial qualifying criteria
b) Technical literature/GTP/Type test report/Details of Qualified Manpower Available/ Testing Facility available etc. *(complete in all respect as desired and detailed in Technical Specification and Technical Requirement Section)*
c) Duly filled Technical and Commercial Deviation Sheets
d) Duly filled formats like Authorization affidavit form
e) *Unpriced Commercial Bid*

The technical / un-priced commercial bid shall be properly indexed and is to be submitted in Soft Copy though E-Tender system of Tata Power. Hard Copy of Technical Bids need not be submitted.

SAFETY BID needs to be submitted along with the technical bid. The format of the safety bid is attached as Annexure.

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Second Part has to be submitted through E-Tender System Only

THIRD PART: "PRICE BID" shall contain only the price details and strictly in Price Bid format along with explicit break up of basic prices and applicable GST. Basic price should include packaging forwarding, freight, transit insurance and any other cost envisaged by the bidder.

FOR BIDS INVITED THROUGH E-TENDER SYSTEM (TECHNICAL AND UN-PRICED COMMERCIAL BID) :

In response to advertisement Bidder has to provide details of person authorized to Bid on behalf of the Bidder. An e-mail will be generated by E-Tender System and the authorized person can download the Tender Documents from the system.
SECOND and THIRD PART of the Bid have to be submitted in E-Tender System.

Bidders have to mandatorily submit SECOND PART (Technical and Un-priced commercial Bid) only through E-Tender system of Tata Power. Bids submitted through any other form/ route shall not be admissible.

SIGNING OF BID DOCUMENTS:

The bid must contain the name, residence and place of business of the person or persons making the bid and must be signed and sealed by the Bidder with his usual signature. The names of all persons signing should also be typed or printed below the signature.

The Bid being submitted must be signed by a person holding a Power of Attorney authorizing him to do so, certified copies of which shall be enclosed.

The Bid submitted on behalf of companies registered with the Indian Companies Act, for the time being in force, shall be signed by persons duly authorized to submit the Bid on behalf of the Company and shall be accompanied by certified true copies of the resolutions, extracts of Articles of Association, special or general Power of Attorney etc. to show clearly the title, authority and designation of persons signing the Bid on behalf of the Company. Satisfactory evidence of authority of the person signing on behalf of the Bidder shall be furnished with the bid.

A bid by a person who affixes to his signature the word 'President', 'Managing Director', 'Secretary', 'Agent' or other designation without disclosing his principal will be rejected.

The Bidder's name stated on the Proposal shall be the exact legal name of the firm.

3.2 Contact Information

Please note all correspondence regarding the tender, bid submission, bid submission date extension, Pre-bid query etc will happen only through Tata Power E-Tender system (Ariba).

No e-mail or verbal correspondence will be responded. All communication will be done strictly with the bidder who have done the above step to participate in the Tender.

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Communication Details:

Package Owner

Name : Mr. Abrar Khan

Contact Number: 9029009468

E-maid ID : abrarkhan@tatapower.com

Escalation Matrix

Group Head Contracts – T&D

Name: Mr. P N Rameshkumar

E-Mail ID: pnramesh@tatapower.com

Bidders are strictly advised to communicate with Package Owner through Tata Power E-tender System (Ariba) only. They need to pay Tender Participation Fee and receive the Ariba log-in. Above escalation details are for reference purpose only.

3.3 Bid Prices

Bidders shall quote for the entire Scope of Supply/ work with a break up of prices for individual items and Taxes & duties. The bidder shall complete the appropriate Price Schedules included herein, stating the Unit Price for each item & total price with taxes, duties & freight up to destination at various sites of Tata Power. The all-inclusive prices offered shall be inclusive of all costs as well as Duties, Taxes and Levies paid or payable during the execution of the supply work, breakup of price constituents.

The quantity break up shown else-where other than Price Schedule is tentative. The bidder shall ascertain himself regarding material required for completeness of the entire work. Any items not indicated in the price schedule but which are required to complete the job as per the Technical Specifications/ Scope of Work/ SLA mentioned in the tender, shall be deemed to be included in prices quoted.

3.4 Bid Currencies

Prices shall be quoted in Indian Rupees Only. It also may be noted that the denomination of Purchase Order / Outline Agreement / Rate Contract and associated Payment to Successful Bidder shall also be in Indian Rupees Only. In case Bidder intends to import any equipment, part etc and supply to Tata Power then all liability and costs related to import will rest with the Bidder. All statutory compliances, payments, expenditure etc related to importing of equipment will be responsibility of the bidder.

3.5 Period of Validity of Bids

Bids shall remain valid for 180 days from the due date of submission of the bid.

Notwithstanding clause above, Tata Power may solicit the Bidder's consent to an extension of the Period of Bid Validity. The request and responses thereto shall be made in writing.

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3.6 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.

3.7 Modifications and Withdrawal of Bids

The bidder is not allowed to modify or withdraw its bid after the Bid's submission. The EMD as submitted along with the bid shall be liable for forfeiture in such event.

3.8 Earnest Money Deposit (EMD)

The bidder shall furnish, as part of its bid, an EMD amounting as specified in the tender. The EMD is required to protect the Tata Power against the risk of bidder's conduct which would warrant forfeiture.
The EMD shall be in following form:

- Bank Guarantee valid for 180 days after due date of submission.

The EMD shall be forfeited in case of:

a) The bidder withdraws its bid during the period of specified bid validity.

Or

b) In case of a successful bidder, if the Bidder, within 15 days, does not
i) accept the purchase order, or
ii) furnish the required Contract Performance Bank Guarantee (CPBG)

Original Bank Guarantee submitted as EMD shall be returned only after completion of award process for unsuccessful bidders and issue of Contract Performance Bank Guarantee (CPBG) for successful bidder.

4. Bid Opening & Evaluation process

4.1 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 Tata Powers processing of Bids or award decisions may result in the rejection of the Bidder's Bid.

4.2 Technical Bid Opening

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Bids will be opened internally by Tata Power. Technical bid must not contain any cost information whatsoever.

First the envelope marked "EMD" will be opened. Bids without EMD of required amount/ validity in prescribed format, shall be rejected.

Next, the technical bid of the bidders who have furnished the requisite EMD will be opened in E-Tender system.

4.3 Preliminary Examination of Bids/Responsiveness

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

Prior to the detailed evaluation, Tata Power 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.

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

4.4 Techno Commercial Clarifications

Bidders need to ensure that the bids submitted by them are complete in all respects. To assist in the examination, evaluation and comparison of Bids, Tata Power may, at its discretion, ask the Bidder for a clarification on its Bid for any deviations with respect to the Tata Power specifications and attempt will be made to bring all bids on a common footing. 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 owing to any clarifications sought by Tata Power.

4.5 Price Bid Opening

Price Bid of only Technically and / or Safety Qualified Bidders shall be considered and open internally by TPC. Bidders will get mail intimation from Tata Power E-Tender system (Ariba) when their Price Bids are opened. The EMD of the bidder withdrawing or substantially altering his offer at any stage after the technical bid opening will be forfeited at the sole discretion of TPC without any further correspondence in this regard.

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.

4.6 Reverse Auction and Price Matching Option

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Tata Power reserves the right to conduct the reverse auction AND / OR Manual Negotiations for the products/ services being asked for in the tender. Only Technical Qualified Bids will be allowed to participate in e-auction. Date and time of e-auction will be intimated through E-Tender system to Authorized Person of Interested Bidder.

For case where more than one bidders have to be awarded (including Rate Contract / Outline Agreement) Price Matching Option will be exercised. Volume of job allocated to original competitive bidder will be more than bidder who is chosen through Price Matching Option. Tata Power decision regarding work sharing shall be final and no explanation OR clarification shall be given regarding the same.

5.0 Award Decision

Tata Power will award the contract to the successful bidder whose bid has been determined to be the lowest-evaluated responsive bid as per the Evaluation Criterion mentioned at Clause 2.0. The Cost for the said calculation shall be taken as the all-inclusive cost quoted by bidder in Priced Bid Format subject to any corrections required in line with Clause 4.3 above. The decision to place purchase order/Outline Agreement/ Rate Contact solely depends on Tata Power on the cost competitiveness across multiple lots, quality, delivery and bidder's capacity, in addition to other factors that Tata Power may deem relevant.

Tata Power reserves all the rights to award the contract to one or more bidders so as to meet the delivery requirement or nullify the award decision without assigning any reason thereof.

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

6.0 Order of Preference/Contradiction:

In case of contradiction in any part of various documents in tender, following shall prevail in order of preference:

1. Outline Agreement/Purchase Order (with Commercial conditions)
2. Special Terms and conditions (if applicable)
3. General Terms and conditions
4. Technical Specifications

In case there is a discrepancy in the BOQ mentioned in tender (to the extent modified through subsequent Corrigendum, if any) and the bid submitted by any bidder, the description as mentioned in the tender (to the extent modified through subsequent Corrigendum, if any) shall prevail.

7.0 Ethics

Tata Power is an ethical organization and as a policy Tata Power lays emphasis on ethical practices across its entire domain. Bidder should ensure that they should abide by all the ethical norms and in no form either directly or indirectly be involved in unethical practice.

Tata Power work practices are governed by the Tata Code of Conduct. Bidder is request to refer Tata Code of Conduct Clause in General Terms and Conditions.

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8.0 General Condition of Contract and Special Condition of Contracts

Any condition not mentioned above shall be applicable as per General Terms and Conditions and Special Condition of Contracts attached along with this tender.

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ANNEXURE I
Schedule for Items

Attached Separately with Tender Document

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NOTE:

- The bids will be evaluated commercially on the overall lowest cost for each line item.
- The unit price with GST in column "Total", is landed price.
- The bidders are advised to quote prices strictly in the above format. Failing to do so, bids are liable for rejection.
- The bidder must fill each and every column of the above format. ***Mentioning "extra/inclusive" in any of the column may lead for rejection of the price bid.***
- No cutting/ overwriting in the prices is permissible.

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ANNEXURE II
Pre-Qualification Requirement

Please Refer Section 1.6 of Tender

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ANNEXURE III
Query / Clarification / Deviation Format

Please note that Editable Soft Copy of Query / Clarification / Deviation Format will be shared through E-Tender System for Participating Bidders

Pre-Bid Queries if any has to be sent through message in E-Tender System. Pre-Bid Query has to be sent only in the Format prescribed below. Technical Pre-Bid Query and Commercial Pre-Bid Query have to be submitted in Separate Editable Excel File in Prescribed Format. Pre-Bid Queries sent in any other format or send through any other communication channel will not be accepted and answered

Format for Query / Clarification / Deviation (QCD)
Tender No
Package Name
Bidder :

Sr. No.	Detailed Reference to concerned Document . Please specify Document No / Clause No / Page No	Description as per Bid Document	Query / Clarification / Deviation	Tata Power Response
1	2	3	4	5

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Annexure IV

Acceptance Form for Participation In Reverse Auction Event

(To be signed and stamped by the bidder)

In a bid to make our entire procurement process more fair and transparent, Tata Power intends to use the reverse auctions through E-Tender system as an integral part of the entire tendering process. All the bidders who are found as technically qualified based on the tender requirements shall be eligible to participate in the reverse auction event.

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

1. Tata Power shall log-in to the authorized representative of the bidder.
2. Tata Power will make every effort to make the bid process transparent. However, the award decision including sharing of work would be final and binding on the supplier.
3. The bidder agrees to non-disclosure of trade information regarding the purchase, identity of Tata Power, bid process, bid technology, bid documentation and bid details.
4. The bidder is advised to understand the auto bid process to safeguard themselves against any possibility of non-participation in the auction event.
5. In case of bidding through Internet medium, bidders are further advised to ensure availability of the entire infrastructure as required at their end to participate in the auction event. Inability to bid due to telephone line glitch, internet response issues, software or hardware hangs, power failure or any other reason shall not be the responsibility of Tata Power.
6. Tata Power has sole discretion to extend or restart the auction event in case of any glitches in infrastructure observed which has restricted the bidders to submit the bids to ensure fair & transparent competitive bidding. In case of an auction event is restarted, the best bid as already available in the system shall become the start price for the new auction.
7. In case the bidder fails to participate in the auction event due any reason whatsoever, it shall be presumed that the bidder has no further discounts to offer and the initial bid as submitted by the bidder as a part of the tender shall be considered as the bidder's final no regret offer. Any offline price bids received from a bidder in lieu of non-participation in the auction event shall be out-rightly rejected by Tata Power.
8. The bidder shall be prepared with competitive price quotes on the day of the bidding event.
9. The prices as quoted by the bidder during the auction event shall be inclusive of all the applicable taxes, duties and levies and shall be FOR at Tata Power site.
10. The prices submitted by a bidder during the auction event shall be binding on the bidder.
11. No requests for time extension of the auction event shall be considered by Tata Power.
12. Detailed price split of E-auction price will be submitted within 24 hours from completion of E-auction. If not submitted, 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 auction event for arriving at Contract amount.

Signature & Seal of the Bidder

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ANNEXURE V

Checklist of all the documents to be submitted with the Bid

Bidder has to mandatorily fill in the checklist mentioned below:-

S. No.	Documents attached	Yes / No / Not Applicable
1	EMD of required value (Original BG to be forwarded on given address and scan copy to be attached with bids)	
2	Duly filled PQR with supporting documents (Annexure II)	
3	Sheet of commercial/ technical deviation if any (Annexure III)	
4	e-Auction undertaking (Annexure IV)	
5	Price bid as per schedule for items (Annexure-I)	
6	Signed copy of this RFQ as an unconditional acceptance	

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ANNEXURE E1 - BILL OF QUANTITY

SUPPLY:	Protection System

Sr. No.	Description	Qty. Set / Nos.	Unit Rate	GST	Total Amount (All Inclusive0
	110 kV KOLSHET R/S - OPTION-1 CONVENTIONAL SYSTEM				
1	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP Data sheet for 110 kV transfer breaker protection system @ Kolshet Station with TYPE-A protection (Protection IED-1,2, SATEC meter) along with its networking accessories IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system	1 Set			
2	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP datasheet for Power transformer-1 & 2 @ Kolshet station with TYPE-D protection (Protection IED-1, 2, SATEC meter) along with its networking accessories between IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system	2 Sets			
	110 kV KOLSHET R/S - OPTION-2 DIGITAL SYSTEM				
3	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP Data sheet for 110 kV Transfer breaker @ Kolshet Station with IEC61850 process bus based TYPE-A1 protection IEDs & MUs along with its networking accessories between IED, MU, gateway, DRCA system etc, relevant LIUs, switches, patch cords, communication system (suitable E1 converters / OPIC cards / communication cards etc. for successful commissioning of line differential protection). Protection panel and MU panel for this bay shall be considered as per specs.	1 Set			

Sr. No.	Description	Qty. Set / Nos.	Unit Rate	GST	Total Amount (All Inclusive0
4	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP datasheet for Power Transformer-1 & 2 @ Kolshet with TYPE-D1 IEC61850 proces bus based protection (Protection IEDs, MUs, one SATEC meter per breaker) along with its networking accessories between IED to MU, IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system. Protection panel and MU panel for this bay shall be considered as per specs.	2 Sets			
	SPARES				
1	Option-1: Conventional Substation One number spare IED of each type, each order code, each MLFB / CORTEC number shall be supplied as spare	1 Set			
2	Option-2: Digital Substation One number spare IED and MU of each type, each order code, each MLFB / CORTEC number shall be supplied as spare				
3	One number spare auxiliary relays used for trip, alarm, supervision, PT selection, contact multiplication etc shall be supplied as spare	1 Set			
4	Laptop for relay configuration and relay settings with following configuration: Only HP make, 15.6 inch, 8GB RAM, 1TB HD, Core i7, with licensed copy of Windows10 OS or higher, 2 number of USB ports, 1 ethernet port, 1 HDMI port, 1 RJ45 port and 1 serial port along with standard laptop carrying back-sack	1 number			
5	Docking station compatible for laptop mentioned above	1 number			

Sr. No.	Description	Qty. Set / Nos.	Unit Rate	GST	Total Amount (All Inclusive0
SERVICES:	**Protection System**				

Sr. No.	Description	Qty. Set / Nos.			
1)	**OPTION-1** (i) Services for commissioning Protection, Automation and communication system along with appropriate human resources, Numerical relay testing kit for conventional and process bus based relay panel commissioning and integration of relays with SCADA system to view disturbance record and Parameterization from remote. (ii) Services from engineer for other make IEDs for commissioning and integration with SAS and communication system.	lump sum			
2)	**OPTION-2** (i) Services for commissioning Protection, Automation and communication system along with appropriate human resources, Numerical relay testing kit for conventional and process bus based relay panel commissioning and integration of relays with SCADA system to view disturbance record and Parameterization from remote. (ii) Services from engineer for other make IEDs for commissioning and integration with SAS and communication system.	lump sum			

Indicative BOM for Automation System at Kolshet Rss for 110kV Bays							
Option-1 (Conventional Automation for Transformer-3, Transformer-4 and Transfer Breaker Bays)							
Sl. No.	**Item**		**Item Description**	**Qty**	**Unit Rate**	**GST**	**Total (All Inclusive)**
Supply							
1	**Ethernet Switches, and Networking Accessories**	**1.1**	**Managed L2 Ethernet Switches for Numerical Relay, Misc RTU Communication & for Gateway Integration** **Mounting Arrangement:** To be mounted in Relay panels / Separate Network Panel **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on Relay quantity & Relay port with 20% spare FO and CU ports on each switch. However, **minimum qty shall be 2 nos.**	1 Set			
		1.2	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) unarmoured multistrand pair and overall shielded for serial communication	500 mtrs			
		1.3	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) armoured multistrand pair and overall shielded for serial communication	500 mtrs			
		1.4	Armoured CAT6 UTP Cable	1000 mtrs			
		1.5	Un-Armoured CAT6 UTP Cable	305 mtrs			
		1.6	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	1000 mtrs			
		1.7	Networking accessories like LIU, patch panel (for each Ethernet switch), patch chords (Fibre optic, UTP) of suitable length, Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc.	1 LOT			
2	**Miscellaneous RTU Panel**	**2.1**	**Pre-wired Miscellaneous RTU Panel with all accessories** **I/O Requirement:** with 128 DI, 64 DO, 16 AI with Auxiliary Relays for each Digital Output **Mounting:** To be supplied with prewired panel (Rittal or equivalent, size : 2300 mm x 800 mm x 800 mm, both side opening)	2 Sets			
3	**MFM**	**3.1**	Multi-Function Meter (SATEC 130EH+)	4 nos			
4	**Spares**	**4.1**	**Mandatory Spares (Refer specification)**	1 Set			
Services							
I1	**Installation, Integration and Commissioning of SAS System**	**I1.1**	**Installation, Integration and Commissioning of SAS System** a) Engineering b) Installation and commissioning of all supplied items c) Cable termination, continuity check of all communication cables d) All Protection Relay,BCU, RTU, MFM looping and Integration with existing Gateway e) Preparation of ICS and Signal List f) Configuration and Testing of IED's, RTUs, Gateway etc. g) Time Synchronization of Gateway, DRCA, IEDs with GPS Receiver h) Integrated testing with purchasers existing Unified SCADA System i) I/O testing, Pre- SAT testing of Hardware and Software functionality j) Integrated FAT & SAT for Hardware and Software k) Submission of as-built drawing in AutoCAD and PDF Format	Lumpsum			
		I1.2	Warranty for Supplied Hardware & Software inclusive of patch management and software upgradation for the period of 5 Years				
	Gateway Services	**I1.3**	Services from APPSIL (ABB) for the Gateway Configuration, Testing and Integration of supplied items/systems at 110kV Kolshet RSS	Lumpsum			
	DRCA Services	**I1.4**	Services of M/s Kalkitech for Configuration, integration with both local DRCA System of the respective station & Centralised DRCA system at 110kV Kolshet RSS	Lumpsum			

Indicative BOM for Automation System at Kolshet Rss for 110kV Bays							
Sl. No.	**Item**		**Item Description**	**Qty**	**Unit Rate**	**GST**	**Total (All Inclusive)**
Option-2 (Process Bus Based Digital Substation for 110kV Tfr-3,Tfr4 & Transfer Breaker Bays)							
O1	Process Bus Panel for Transfer Breaker	O1.1	**Redundant MUs with BI/BOs along with accessories per Bay for Transfer Breaker** **IO Requirement & Quantity :** Refer Protection Specification **Communication Port :** Redudant Fiber Optic Ports on PRP **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Mounting:** To be installed in the Process Bus Panel	1 Set			
		O1.2	**Non -redundant SCUs with accessories per Bay for BCU for Transfer Breaker** **I/O Requirement :** with 64 DI, 20 DO **Communication Port :** Redudant Fiber Optic Ports **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Quantity** - 1no **Mounting:** To be installed in the Process Bus Panel along with MUs	1 Set			
O2	Process Bus Panel for Tranformer	O2.1	**Redundant MUs with BI/BOs along with accessories per Bay for Tranformer** **IO Requirement & Quantity :** Refer Protection Specification **Communication Port :** Redudant Fiber Optic Ports on PRP **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Mounting:** To be installed in the Process Bus Panel	2 Sets			
		O2.2	**Non -redundant SCUs with accessories per Bay for BCU** **I/O Requirement :** with 64 DI, 20 DO **Communication Port :** Redudant Fiber Optic Ports **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes Quantity - 1no **Mounting:** To be installed in the Process Bus Panel along with MUs	2 Sets			
O3	GPS Receiver	O3.1	**Redudant GPS Receiver ,Clock with Time, Date and Frequency Display Unit with antenna, Surge protector and cables for Process Bus & Station Bus** **Mounting Arrangement :** GPS Receiver to be mounted in Gateway Panel **Ports :** 4nos of IEEE1588 (PTP) FO/Ethernet Ports for Process Bus & 4nos SNTP Ports for Station Bus Communication **Power Supply**: Redundant 220 V /110 V DC Mounting : Shall be mounted in Gateway panel. **Remote display Mounting :** Time, Date and Frequency Display Unit on a wall in C/R or R/R	1 Set			
O4	Process Bus Communication Switches, Networking	O4.1	**Pre-wired Network Panel (Near Process Bus Panel) with Managed L3/L2 Ethernet Switches for Process Bus equipment integration with Station Bus** **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on IED quantity & ports with 20% spare FO and CU ports on each switch. **Communication Network :** PRP **Power Supply:** Redundant 220 V /110 V DC **Mounting Arrangement:** To be mounted in a Separate Network Panel.	1 Set			
		O4.2	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	2000			

Sl. No.	Item		Item Description	Qty	Unit Rate	GST	Total (All Inclusive)
	Accessories forSAS	O4.3	Armoured CAT6 UTP Cable	500			
		O4.4	Networking accessories like Redundant LIU, Redudant patch panel (for each Ethernet switch), Pre-fabricated Patch cords (Fibre optic, UTP) of suitable length, Unarmoured UTP Cables,HDPE Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc. (Refer the specifications more details)	1Lot			
O5	Station Bus - Bay Control Unit (BCU)	O5.1	**Non-Redundant BCU for Transfer Breaker & Transfromer** **Power Supply :** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Communication port :** Independent Redundant FO Port for Process Bus and Station Bus **Mounting:** To be installed in the Protection relay Panel along with the protection relays	3 Sets			
O6	Pre-wired RTU Panel	O6.1	**Pre-wired RTU Panel with all accessories** **I/O Requirement:** with 128 DI, 64 DO, 16 AI with Auxiliary Relays (Omron Relay)for each Digital Output **Mounting:** To be supplied with prewired panel (Rittal make ; size : 2300 mm x 800 mm x 800 mm, both side opening)	1 Set			

Sl. No.	Item		Item Description	Qty	Unit Rate	GST	Total (All Inclusive)
O7	Communication Switches, Networking and other Accessories	O7.1	**Managed L2 Ethernet Switches for Numerical Relay, Misc RTU Communication & for Gateway Integration** **Mounting Arrangement:** To be mounted in Relay panels / Separate Network Panel **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on Relay quantity & Relay port with 20% spare FO and CU ports on each switch. However, **minimum qty shall be 2 nos.**	1 Set			
		O7.2	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) unarmoured multistrand pair and overall shielded for serial communication	500 mtrs			
		O7.3	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) armoured multistrand pair and overall shielded for serial communication	500 mtrs			
		O7.4	Armoured CAT6 UTP Cable	1000 mtrs			
		O7.5	Un-Armoured CAT6 UTP Cable	305 mtrs			
		O7.6	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	1000 mtrs			
		O7.7	**Configuration Laptop** **Hardware:** Laptop with latest processor, 500 GB HDD, 8 GB RAM, DVD RW, 4 USB Ports, 15" Display with 1 no. serial to USB converter **Power Supply:** 230 V DC Microsoft Windows compatible with latest version of configuration software, latest Microsoft Office License pack, Antivirus Quick heal Total Security with three-year subscription, Configuration & maintenance software tools, Diagnostic tools. Logic building Application of SCU,BCU,RTU and Process Bus related Configurations	1 Set			
		O7.8	Networking accessories like LIU, patch panel (for each Ethernet switch), patch chords (Fibre optic, UTP) of suitable length, Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc.	1 Lot			
O8	MFM	O8.1	Multi-Function Meter (SATEC 130EH+)	4 nos			
O9	Spares	O9.1	Mandatory Spares (Refer specification)	1 Set			
I1	Installation, Integration and Commissioning of SAS System	I1.1	**Installation, Integration and Commissioning of SAS System** a) Engineering b) Installation and commissioning of all supplied items c) Cable termination, continuity check of all communication cables d) All Protection Relay,BCU, RTU, MFM looping and Integration with existing Gateway e) Preparation of ICS and Signal List f) Configuration and Testing of IED's, RTUs, Gateway etc. g) Time Synchronization of Gateway, DRCA, IEDs with GPS Receiver h) Integrated testing with purchasers existing Unified SCADA System i) I/O testing, Pre- SAT testing of Hardware and Software functionality j) Integrated FAT & SAT for Hardware and Software k) Submission of as-built drawing in AutoCAD and PDF Format	Lumpsum			
		I1.2	Process bus Based Digital Substation - Warranty for Supplied Hardware & Software inclusive of patch management and software upgradation for the period of 10 Years				
	Gateway Services	I1.3	Services from APPSIL (ABB) for the Gateway Configuration, Testing and Integration of supplied items/systems at 110kV Kolshet RSS	Lumpsum			

Sl. No.	Item		Item Description	Qty	Unit Rate	GST	Total (All Inclusive)
	DRCA Services	I1.4	Services of M/s Kalkitech for Configuration, integration with both local DRCA System of the respective station & Centralised DRCA system at 110kV Kolshet RSS	Lumpsum			
			Services for OSI SCADA				

SECTION B- TECHNICAL SPECIFICATIONS

TATA POWER

Technical Specifications (Annexure to Tender Documents)

CONFIDENTIAL

Document Title: SPECIFICATIONS FOR PAC SYSTEM FOR 03 NOS OF BAYS AT KOLSHET RSS

Document No: TE/SP/0004/FY22

TATA POWER

The Tata Power Company Limited

Engineering T&D, Powai Receiving Station Near Kailash Complex,

Park Site Road, Vikhroli (W) Mumbai 400 079

Registered Office Bombay House 24 Homi Mody Street Mumbai 400 001

Revision	Date	Revision History	Approvals		
			Prepared By	Checked By	Approved By
A	22.02.2021	Issued for Review & Comment	VK / VS	VAS	AM / RKS / SVD
B	26.04.2021	FINAL	VK / VS	VAS	AM / RKS / SVD

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29.04.2021

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A1 INTENT OF SPECIFICATION:

1.1 Tata Power Company Limited (Tata Power) hereinafter called the "OWNER" or "PURCHASER", proposes prewired protection, automation and communication system for 03 nos of bays (110/22kV Transformer-1, 110/22kV Transformer-2 & 110kV Transfer breaker)

1.2 The scheme is proposed to be implemented at Kolshet receiving stations of Tata Power as mentioned in the specifications.

A2 PROJECT INFORMATION

1.0	Owner	The Tata Power Company Limited Kolshet Receiving station, Ghodbunder Road, Near Tikuji Ni Wadi, Thane West - 400607, Maharashtra, India
2.0	Consultant	Nil
3.0	Location of the plant	Tata Power Kolshet receiving stations
4.0	Nearest Rail head	Site is connected by rail at CST, Mumbai.
5.0	Transport	Access roads are available for movement of materials to site. Movement of heavy materials would be through existing roads/rail up to site.
6.0	Plant Elevation	About 6 m above mean sea level
7.0	Climatic conditions	
7.1	Temperatures:	
(a)	Maximum dry bulb temperature	36.7^0 C
(b)	Minimum dry bulb temperature	18.3^0 C
(c)	Design temperature for electrical equipment / devices	50^0C
(d)	Design humidity	95%
7.2	Relative humidity	
	(a) Maximum during monsoon	100%

(b) Minimum during December to January — 22%

8.0 Rainfall — Annual average rainfall is about 2500 to 3100 mm (most of which occurs during the monsoon season from June to September)

9.0 Wind data

Calculations for wind effect shall be in accordance with IS: 875 (Part-3) taking into account the following:

(i) Basic wind speed = 44 m/sec
(ii) Factor K1, K2, K3 = as per IS 875 Part-3
(iii) Category of terrain = as per IS 875

10.0 Seismic conditions — The proposed site is located in seismic zone III as per the Indian Standard IS 1893 and importance factor of 1.75.

11.0 Air Quality — Atmosphere polluted with industrial gases and wastes because of proximity to petroleum refineries and fertilizer complex.

12.0 Sea water temperature

(a) Maximum — 36.7^0 C
(b) Minimum — 22.8^0 C
(c) Average — 29.8^0 C

13.0 Auxiliary Power Supply:

Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following system:

(a)	AC Power Supply System for Station Auxiliaries	415V AC, 3-phase, 4-wire solidly grounded system
(b)	AC Power Supply System for Lighting fixtures and space Heaters	240V, 1 phase, 2 wire, 50Hz AC supply with neutral lead grounded derived from (a)
(c)	Uninterrupted Power Supply	240 V, 1-phase, 50 Hz, 2-wire, AC supply
(d)	Construction Power Supply	415V, 3 phase, 4 wire, 50Hz AC supply solidly grounded

(e)	DC Power Supply System for Protection and Control	220V (Bidder shall supply universal power supply, BI supply relay)
(f)	DC Power Supply System for SCADA	48 V DC, 2-wire ungrounded DC supply
(g)	Communication Supply	48 V DC Positive grounded, 2 wire DC supply
(h)	The above voltages may vary as follows: All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance. AC supply Voltage variation ± 10% Frequency variation ± 5% Combined voltage & frequency variation 10%	

14 SCOPE OF WORK

a. Scope of work for Protection and Automation shall be as per Section B all the chapters.

b. Bidder shall meet prequalification requirement of both conventional and digital susbstation to participate in this bid

c. Addition of switches, LIU, patch cord, networking accessories etc for completion of scheme and as per Automation and Communication specifications shall be in bidders scope.

d. Control cable laying, termination and necessary civil work at site is excluded from bidders scope. The same will be executed by Tata Power.

1.1.1 Protection System

Option-1: Conventional System

Bidder shall refer to Section B Chapter 2A Standard Technical Specifications for control and relay protection system for 110kV Kolshet RSS. For all transformers, 3-winding differential relays shall be considered. One SATEC make PM130EH Plus model meter per transformer breaker shall be provided. Bidder shall provide protection system for the following bays at Kolshet RSS:

Equipment name	Protection to be provided at local Kolshet end
110kV Transfer breaker	TYPE-A
110/22 kV Transformer-1	TYPE-D
110/22 kV Transformer-2	TYPE-D

Option-2: IEC61850 sampled value based digital protection sytem

Detailed scope & requirement of process bus based Protection relays, control and schemes are elaborated in **Section B Chapter 2B** of this document. Bays shall be provided with process bus based digital protection system.

Bidder shall guarantee the performance and demonstrate complete interoperability between MU's and relays of different make. In case of failure of one MU, the other MU of same bay shall automatically switch in and communicate with both the IEDs on station bus and process bus to keep both Main-1 & Main-2 protections in service at all the times.

Equipment name	Protection to be provided at local Kolshet end
110kV Transfer breaker	TYPE-A1
110/22 kV Transformer-1	TYPE-D1
110/22 kV Transformer-2	TYPE-D1

For each process bus based bay protection panel, a Bay Control Unit (BCU) relay shall be considered as per Automation specifications. The BCU shall be installed in protection panel whereas SCU shall be part of Process Bus Panel. For all transformers, the 3-winding differential relays shall be considered. One SATEC make PM130EH Plus model meter per transformer breaker shall be provided in Process Bus Panel.

Along with protection panel, a separate outdoor type, IP65 class, process bus based panel consisting Merging Units (MU) shall be supplied for each bays. These panels will be placed

in switchyard. Following table shows approximate process Bus Panels which are to be supplied and commissioned by bidder under this project:

Outdoor Process Bus Panel Number	MU related to following bays shall be installed in a panel:
Process Bus Panel-1	Transfer breaker
Process Bus Panel-2	Transformer-1 HV side
Process Bus Panel-3	Transformer-1 devices
Process Bus Panel-4	Transformer-1 LV-1 & 2 side
Process Bus Panel-2	Transformer-2 HV side
Process Bus Panel-3	Transformer-2 devices
Process Bus Panel-4	Transformer-2 LV-1 & 2 side

The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder unless otherwise indicated. Bidders to supply one spare each of numerical protection relay, trip relay, trip supervision relay and auxiliary relay, MU etc. Bidder to submit spare list along with bid for review and evaluation.

Bidder is supposed to give their best offers for Option-1 as well as Option-2. During bid stage, based on techno commercial aspects, Tata Power will decide to go with either Option-1 or Option-2.

1.1.2 Sub-Station Automation System

Scope covers the Sub-Station Automation System for 110 kV PAC system at Kolshet RSS as per following design.

Bidder shall offer Automation solution for the following options

Option-1 (Conventional System)

a) Design, Engineering of SAS (without Process Bus),Installation, Testing,Commissioning & integration with Existing Gateway system & Purchaser's SCADA. Please refer Section B, Chapter 2.3 B for Substation Automation Specification along with annexures & other Sections of the RFP.

The scope under this includes complete design, detailed engineering, preparation of ICS, manufacture, supply, inspection & testing at Bidder's work, packing, transportation, delivery to site, supervising erection and installation, coordination with other vendors, Integrated testing, commissioning, performance testing and handing over of Substation Automation System for 110 kV system and their associated lines connected systems at remote end.

All equipment, system and services covered under this specification shall comply with all current applicable statutory regulations and safety codes in the locality where the equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder, unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Bidder shall refer the entire project specifications to understand the execution methodology and interface equipment specification for the complete Scope of work of this project. Bidder shall offer the SAS Supply & Services accordingly.

Option-2 (Process bus based Digital Substation Bays)

b) Design, Engineering, Installation, Testing, Commissioning & integration of Complete Process Bus based Digital Substation of 110kV Bays and seamless integration with Existing Gateway System & Purchaser's SCADA. Please refer Section B, Chapter 2.3 E for Substation Automation Specification along with annexures & other Sections of the RFP.

Bidder shall note that the proposed Process bus based digital substation solution has to be validated by their principal /Global technical expertise team on digital Substation.

The scope under this includes complete design, detailed engineering, preparation of ICS, manufacture, supply, inspection & testing at Bidder's work, packing, transportation, delivery to site, supervising erection and installation, coordination with other vendors, Integrated testing, commissioning, performance testing and handing over of Substation Automation System for 110 kV system and their associated lines connected systems at remote end.

All equipment, system and services covered under this specification shall comply with all current applicable statutory regulations and safety codes in the locality where the equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder, unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Bidder shall refer the entire project specifications to understand the execution methodology and interface equipment specification for the complete Scope of work of this project. Bidder shall offer the SAS Supply & Services accordingly.

A10.3 COMMUNICATION SYSTEM

NA

A4 TERMINAL POINTS

NA

A5 EXCLUSIONS:

NA

A6 CODES AND STANDARDS:

1.0 As specified in respective standard specification of equipments

A7 BIDDER'S QUALIFICATION REQUIREMENTS

As per standard specifications.

A8 PROJECT SCHEDULE / MILESTONES

Bidder shall submit with the bid, a detailed Project Schedule covering the following based on the milestones tabulated below:

Sr. No.	Milestone	Target
1	PO Placement	Zero Date
2	MDL & Project Detailed Project Execution Schedule submission & approval	Within 2 weeks from Sr. No. 1
3	Drawing submission & approval	Within 4 weeks from Sr. No. 1
4	Inspection of equipment	Within 6 weeks from Sr. No. 3

5	Delivery of equipment	Within 1 week from Sr. No. 4
6	Completion of installation	Within 1 months from Sr. No. 5

A9 SUBMISSIONS BY BIDDERS

As per standard specifications.

A11 LAYOUT REQUIREMNETS

As per standard specifications.

A12 QUALITY REQUIREMENTS

As per standard specifications.

A13 PERFORMANCE REQUIREMENTS

As per standard specifications.

A14 MAINTAINANCE REQUIREMENTS

As per Standard Specifications provided in Section B

A15 TOOLS AND TACKLES FOR ERECTION AND COMMISSIONING

As per Standard Specifications provided in Section B

A16 SPARES

As per standard specifications.

B2 –STANDARD SPECIFICATIONS

Refer Standard Technical specification for Scope of Work and Equipments

ANNEXURE E1 - BILL OF QUANTITY

SUPPLY:	Protection System

Sr. No.	Description	Qty. Set / Nos.	Price quoted by bidder in INR
	110 kV KOLSHET R/S - OPTION-1 CONVENTIONAL SYSTEM		
1	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP Data sheet for 110 kV transfer breaker protection system @ Kolshet Station with TYPE-A protection (Protection IED-1,2, SATEC meter) along with its networking accessories IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system	1 Set	
2	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP datasheet for Power transformer-1 & 2 @ Kolshet station with TYPE-D protection (Protection IED-1, 2, SATEC meter) along with its networking accessories between IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system	2 Sets	
	110 kV KOLSHET R/S - OPTION-2 DIGITAL SYSTEM		
3	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP Data sheet for 110 kV Transfer breaker @ Kolshet Station with IEC61850 process bus based TYPE-A1 protection IEDs & MUs along with its networking accessories between IED, MU, gateway, DRCA system etc, relevant LIUs, switches, patch cords, communication system (suitable E1 converters / OPIC cards / communication cards etc. for successful commissioning of line differential protection). Protection panel and MU panel for this bay shall be considered as per specs.	1 Set	
4	Completely wired Simplex Control and Protection Relay Panel comprising of all the Protection Schemes & accessories as per GTP datasheet for Power Transformer-1 & 2 @ Kolshet with TYPE-D1 IEC61850 proces bus based protection (Protection IEDs, MUs, one SATEC meter per breaker) along with its networking accessories between IED to MU, IED to gateway, IED to DRCA system, relevant LIUs, switches, patch cords and any other necessary communication system. Protection panel and MU panel for this bay shall be considered as per specs.	2 Sets	
	SPARES		
1	One number spare IED and MU of each type, each order code, each MLFB / CORTEC number shall be supplied as spare	1 Set	
2	One number spare auxiliary relays used for trip, alarm, supervision, PT selection, contact multiplication etc shall be supplied as spare	1 Set	
3	Laptop for relay configuration and relay settings with following configuration: Only HP make, 15.6 inch, 8GB RAM, 1TB HD, Core i7, with licensed copy of Windows10 OS or higher, 2 number of USB ports, 1 ethernet port, 1 HDMI port, 1 RJ45 port and 1 serial port along with standard laptop carrying back-sack	1 number	
4	Docking station compatible for laptop mentioned above	1 number	

Sr. No.	Description	Qty. Set / Nos.	Price quoted by bidder in INR

SERVICES:	Protection System

Sr. No.	Description	Qty. Set / Nos.	
1)	**OPTION-1** (i) Services for commissioning Protection, Automation and communication system along with appropriate human resources, Numerical relay testing kit for conventional and process bus based relay panel commissioning and integration of relays with SCADA system to view disturbance record and Parameterization from remote. (ii) Services from engineer for other make IEDs for commissioning and integration with SAS and communication system.	lump sum	
2)	**OPTION-2** (i) Services for commissioning Protection, Automation and communication system along with appropriate human resources, Numerical relay testing kit for conventional and process bus based relay panel commissioning and integration of relays with SCADA system to view disturbance record and Parameterization from remote. (ii) Services from engineer for other make IEDs for commissioning and integration with SAS and communication system.	lump sum	

B.1_CHAPTER-2A

SECTION-B

THE TATA POWER COMPANY LIMITED

STANDARD
TECHNICAL SPECIFICATION
FOR

CONTROL AND RELAY PROTECTION SYSTEM FOR SUBSTATION AND ASSOCIATED EQUIPMENTS

(DOCUMENT NO - ENGG/ ELECT/STD-SPECS/70)

Tata Power

Engineering T & D

Rev. No	Date	Revision History	Prepared By	Checked By	Approved By (HOD)
R0	17-08-2018	First Copy	VK/VAS	SVD	AM
R1	10-06-2019	Revision based on learnings	VK/VAS	AM	PC
R2	31-03-2020	Revised PQR, Function key	VK/VAS	SVD	AM
D	21-11-2020	Addition of reactor protection, Rittal panel & Elmex TB	VK/VAS	SVD	AM
E	18-01-2021	Modification in TYPE-G UFLS	VK/VAS	SVD	AM
F	22-02-2021	Addition of high impedance BF	VK/VAS	SVD	AM

29.04.2021

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1. INTRODUCTION

The Technical specification covers the complete design, detailed engineering, manufacture, supply, inspection & testing at Bidder's work, packing, transportation, delivery to site, performance testing, commissioning and handing over of Protection, Providing Technical Support for Protection system for substation equipment. All equipment, system and services covered under this specification shall comply with all current applicable statutory regulations and safety codes in the locality where the Equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

2. PRE-QUALIFYING REQUIREMENTS AND APPROVED VENDORS LIST

Please refer Annexure-1 for bidders pre-qualifying requirement.

3. SYSTEM DESCRIPTION AND SCOPE

The scope of work shall include but not limited to following:

3.1. Design, manufacture, testing at works, combined Protection-Automation FAT performance testing, supply, transport to site, preparation of drawings, Interconnecting Schedule (ICS), relay configurations, services for testing and commissioning of Protection Panels at site with standard engineering practices, IS & IEC standards.

3.2. Protection IEDs integration scope by Bidder includes all networking accessories such as switches, LIU, patch panel, I/O boxes, patch cords, communication cables supply, laying & looping of the devices for the procured system.

3.3. All the relays in one substation shall be wired in network with an industrial grade computer having necessary software, which will communicate with all relays to display alarms, sequence of event logs, carry out setting changes, configuration logic modifications, down loading & analysis of fault records, monitoring and alarm functions, remote communication

with the existing DRCA system. The time synchronization for all the IEDs shall be through SNTP. Immediate communication with time stamping shall be ensured.

3.4. Preparation relay configuration, relay settings and its approval from Tata Power before integrated FAT shall be in bidder's scope. The FAT shall not be commenced unless relay configuration and settings approved by purchaser team.

3.5. Combined Protection, automation and communication FAT for 100% of panels at Bidders factory with Tata Power approved load service relay setting and configuration is in Bidders scope.

3.6. Remote end protection CRP or lose relay supply for overhead line / underground cable, testing, commissioning, integration with local and remote end existing protection, automation architecture as mentioned case to case basis in relevant sections shall be in bidders scope.

3.7. Preparation of Interconnecting cable schedule (ICS) mentioning each end TB number, cable core, cross section, number of cable required etc with all existing field equipment is in Bidders scope.

3.8. For remote end retrofitting – Preparing total CRP drawing with retrofitted relay, getting drawing approval from Tata Power, removal of old relay, matching panel cutout, wiring of new relay and commissioning etc shall be in bidders scope .

3.9. Demonstration / testing of the system at Bidder's works as per the approved Tata Power SQP (attached Annexure-2 with the specifications) before dispatch of the system at site (FAT).

3.10. The commissioning of the entire system being procured under this requirement as per project schedule shall be in bidder's scope.

3.11. The relay setting, configuration tool / software shall be freely available to user during entire duration of relay support. If bidder has licensed version of software, it shall provide at least 10 licenses or licenses equal to as many number of IEDs, whichever is higher for purchasers use.

3.12. Numerical relay testing kit required for site commissioning shall be in bidder's scope.

3.13. Bidder to depute people for supervision & validation of commissioning check points & site equipment test results during Installation, testing & commissioning of the protection and automation system as per Tata Power approved Standard Field Quality Plan (attached with the specifications). The technical expert shall be involved until the equipment is commissioned & handed over.

3.14. Wherever the system is being commissioned in the existing substations, the complete integration of the new system vis a vis existing system of protection, automation and communication shall be in bidder's scope. Wherever necessary, bidder shall do the site visit and take all the relevant information during pre-bid at bidders cost.

3.15. All required man, material, upgradation, replacement, retrofitting etc for seamless integration of new system with existing system shall be in bidder's scope.

3.16. Bidder shall adhere to General requirements of Quality Assurance & Inspection (attached with the specifications).

3.17. Submission of type test report which is not more than 5 years old.

3.18. Bidder must agree for handing over, to Purchaser, all project related drawings in AutoCAD format only. The pdf versions of above drawings shall be submitted through "Wrench" project management software for formal approval process.

3.19. It is not the intent of this specification to specify completely herein, all details of design & construction protection, automation and communication system. However, the bidder shall include and supply the required material and resource at any stage of the project for successful commissioning of the system. The equipment shall conform in all respects to high standards of engineering, design & workmanship.

4. CODES & STANDARDS

4.1. CBIP protection guidelines (Publication No: 274)

4.2. The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be

installed. Nothing in this specification shall be construed to relieve vendor of this responsibility.

4.3. Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC Standards as given below:

Sr No	Standard no.	Title
Characteristic, Performance, Accuracy, Burden, Mechanical endurance test		
1	IEC-60255-6	> Thermal requirements > Mechanical requirements > Limiting dynamic value > Accuracy requirements > Rated Burden
2	IEC-60255-11	Interruption to and alternating component in DC aux. Energizing quantity
3	IEC-60255-3, IEC-60255-12, IEC-60255-13	Relay characteristic & Performance test
4	IEC-60255-23	Contact Performance test
Electromagnetic Compatibility type test:		
1	IEC-60255-22-1, Class-III,	1MHz burst immunity test
2	IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III	Electrostatic discharge test Direct application Indirect application
3	IEC-60255-22-4, Class-A	Fast transient / burst immunity test
4	IEC-, 60255-22-5	Surge immunity test
5	IEC-60255-22-7, Class-A	Power frequency immunity test
6	IEC-61000-4-8, Class-V	Power frequency magnetic field Test
7	IEC- 60255-22-3	Radiated electromagnetic field Immunity
9	IEEE/ANSI/C37.90.2	Radiated electromagnetic field Disturbance
10	IEC- 60255-22-3	Immunity to conducted disturbances induced by radio frequency fields test
11	IEC- 60255-25	> Electromagnetic emission tests > Conducted emission test > Radiated emission test
Insulation tests:		
1	IEC- 60255-5	Dielectric test Impulse voltage test Insulation resistance

Sr No	Standard no.	Title
Environmental tests:		
1	IEC-60068-2-1	Cold test
		Storage test
2	IEC-60068-2-2	Dry heat test
3	IEC-60068-2-3	Damp heat test, steady state
4	IEC-60068-2-30	Damp heat test, cyclic
5	IEC-60068-2-48	Storage temperature test
CE compliance		
1	IEC- 60255-26	Electromagnetic compatibility Requirements
Mechanical tests		
1	IEC- 60255-21-1	Vibration
2	IEC- 60255-21-2	Shock and bump
3	IEC- 60255-21-3	Seismic
Degree of protection test		
1	IEC 60529	Degree of Protection Provided by enclosure test
Safety test		
1	IEC 61010-1	> Single fault condition assessment > Earth bonding impedance test Mechanical resistance to shock and Impact > Rigidity test > Impact hammer test > Protection against electrical shock Protection against the spread of fire

5. DESIGN REQUIREMENTS

5.1. All the IED's supplied shall have conformal coating as per relevant standards.

5.2. Following is the protection function requirement in IEDs as per bay equipment:

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Approx. Minimum number of Binary Input / Output ($)
TYPE-A 110 kV / 220 kV Line / Transfer breaker protection	IED-1: IED with Dist (with 1-ph Auto reclose) + Diff + Dir OC/EF + Dir OLTS + LBB + Over voltage + Sync check	Main-1 & 2 IED's shall be from different OEM. For 3 terminal lines, the differential modules shall be provided accordingly. The two-terminal line relays shall be modular type and shall have capability to upgrade to 3-terminal. Empty slots for analog card and FO port shall be kept for future 3-terminal line expansion. Minimum 4 setting groups shall be available in each IED for line protection. For transfer breaker, minimum 06 nos of setting group facility is required.	2	24/24 + (6 nos of signal channels for transmitting binary signals from one end to other end via differential fibre)
	IED-2: IED with Dist (with 1-ph Auto reclose) + Diff + Dir OC/EF + Dir OLTS + LBB + Over voltage + Sync check			24/24 + (6 nos of signal channels for transmitting binary signals from one end to other end via differential fibre)
TYPE-B 110 kV / 220 kV Buscoupler / Bus section breaker	One IED with Directional OC/EF + LBB + Sync check	Minimum 4 setting groups shall be available in IED.	1	8/8
TYPE-C 220-110/33 kV (HV-MV/LV) Auto Transformer / ICT	**Group-1:** IED-1: IED with Overall Biased Differential + NGT High imp REF + Over fluxing + Thermal O/L + ICT SEF + LV OC + LV LBB + Sync check + HV Dir OC/EF + LBBU	Group-1 & Group-2 IEDs shall be from different manufacturer. The Group-1 & Group-2 IEDs shall be capable handling differential protection between at least 5	2	24/24

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Approx. Minimum number of Binary Input / Output ($)
	Group-1: IED-2: ICT High impedance REF (Phase wise 3-ph protection) + NGT SEF + MV Teed + MV Dir OC/EF + MV LBB + MV OLTS + LV OLTS	winding/breakers along with other functions mentioned for respective IEDs.		24/24
	Group-2: IED-1: IED with Overall Biased Differential + NGT High imp REF + Over fluxing + Thermal O/L + ICT SEF + LV OC + LV LBB + Sync check + HV Dir OC/EF + LBBU			24/24
	Group-2: IED-2: ICT High impedance REF (Phase wise 3-ph protection) + NGT SEF + MV Teed + MV Dir OC/EF + MV LBB + MV OLTS + LV OLTS			24/24
TYPE-D 110/33 kV, 110/22 kV Delta-Star (^Star-Delta) Power transformer	IED-1: Biased Diff + HV Dir OC EF + HT LBB + LV (^HV) Low Imp REF + SEF + LV-1 OC + LV-1 LBB	Main-1 & 2 IED shall be from different manufacturer. These IEDs shall also be capable handling differential protection between at least 3 winding/breakers along with other functions mentioned for respective IEDs.	2	24/24
	IED-2: Biased Diff + HV Dir OC EF + HT LBB + LV (^HV) Low Imp REF + SEF + LV-2 OC + LV-2 LBB			24/24
	IED-3: LV OLTS (^NGT High imp REF + NGT SEF)			12/12

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Approx. Minimum number of Binary Input / Output ($)
TYPE-E 110 / 220 kV GIS busbar protection	Scheme-1 - IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection	Total number of bays covered in this protection is mentioned in respective sections. Bidder shall consider additional 4 number of bays along with mentioned bays for future expansion in respective section during design of bus differential	2	As per requirement of SLD scheme (at least 4 additional bays shall be kept for future expansion)
TYPE-F 110 / 220 kV AIS busbar protection	Scheme-1: IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection Scheme-2: IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection	Scheme-1 & 2 shall be 100% redundant and shall be from different manufacturer. Total number of bays covered in this protection is mentioned in respective sections. Bidder shall consider additional 4 number of bays along with mentioned bays for future expansion in both IED-1 & 2 during design of bus differential protection. The IED-1 & 2 scheme shall be 100% redundant including its lockouts.	4	As per requirement of SLD scheme (at least 4 additional spare bays shall be kept in each IED for future expansion)
TYPE-G Under frequency load shedding	IED with 5 stages of Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration	IED shall have setting auto changeover facility. Minimum 4 settings group required.	1	18/18
TYPE-H 110 / 220 kV Reverse Power Under	Main-1: IED with 5 stages of Reverse Power protection + Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration	Main-1 & 2 IEDs shall be from different manufacturer. Minimum 4 settings group required. Each relay shall have capability to take	2	18/18

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Approx. Minimum number of Binary Input / Output ($)
Frequency Islanding scheme	Main-2: IED with 5 stages of Reverse Power protection + Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration	analog inputs from 4 bay CTs for internal CT summation for reverse power calculation based on Section-A.		18/18
TYPE-I 110/220 kV Reactor Protection	IED-1: Biased Differential + Impedance protection + Directional OC & EF + LBBU + Standby EF + Phase wise High impedance REF + Overfluxing + Overvoltage + Undervoltage + Thermal overload	IED-1 & 2 shall be from different manufacturers. IED shall have minimum 4 settings group.	2	24/24
	IED-2: Biased Differential + Impedance protection + Directional OC & EF + LBBU + Standby EF + Phase wise High impedance REF + Overfluxing + Overvoltage + Undervoltage + Thermal overload			24/24
TYPE-J High impedance bus fault protection	Zone-1 IED-1: High impedance bus fault protection + CT supervision alarm & blocking Zone-2 IED-2: High impedance bus fault protection + CT supervision alarm & blocking IED-3: Blind zone protection	Total 03 nos of IEDs shall be supplied. IEDs shall have dedicated high impedance protection function in relay.	2	16/16

Table-1: Details of protection

($ The number of BI/BO specified are minimum and approximate. The number of panels is indicative. The bidder shall consider any additional requirement depending upon the scheme requirement)

5.3. Each of the above-mentioned relay shall have at least 5 number of user configurable function keys for making IN/OUT of different functions in the relay through local operation. For remote operation, relay shall be capable of receiving commands of IN/OUT through

IEC61850 from SCADA. The relay shall have at least 20 nos of user configurable memory-based Set-Reset Flip Flops for IN/OUT of the relay internal functions. Relay shall be capable of achieving complete bi-stable IN/OUT relay type scheme by using function keys and user configuration logics.

5.4. All the signals viz. Carrier send, carrier receive, DT send, DT receive, Differential Intertrip, Differential Comm fail, Differential OUT, Earth switch ON status etc shall be routed through differential fibre. There shall be at least 6 digital channels available in differential relay for routing these signals through differential fibre to remote end relay.

5.5. Optical modules of the all line Differential relays shall support C37.94 protocol and should be integrable with SDH mux's, MPLS devices supporting C37.94 interface. The interface should be capable of transferring simultaneously carrier acceleration, Differential Protection, Direct trip and other protection functionalities on single optical port.

5.6. The numerical protection relays shall have the following features:

5.3.1. ACCESS / COMMUNICATION

i. Local Operating Interface: USB / Ethernet / RS232 Port / Serial Port on Front Panel preferably USB or optically isolated 9-pin DSUB for the configuration and monitoring of the relay locally.

ii. All protection relays shall be of numerical type (IED's) with fibre optic communication interface compliant to IEC-61850 protocol with dedicated dual ports. It shall be possible to fully utilize the metering, protection and control features of the numerical relays. They shall have programmable logic facility with built-in timers. Apart from the status of operation of the protection functions inbuilt in the relay, it is proposed to utilize the binary inputs of the relay for taking the operation of other non-communicable relays (if any) in the protection panel to SCADA/DCS.

iii. The numerical relays shall be selected with suitable number of binary/analog inputs and outputs. The IEC-61850 compliant numerical relays shall in turn be connected to two switches either in a daisy chain mode or connected radially, so that loss of one

connection does not result in loss of communication with any device. These switches shall be provided with fibre optic (FO) ports for interconnection with all other switches supplied by others which form part of the IEC-61850 LAN network. Further, communication to the Plant DCS shall be through two nos. gateways supplied by others. Events shall be time stamped in the protective relays with a resolution of 1 ms. Time synchronizing pulse in SNTP format shall be transmitted to all devices in the entire network through any two of the managed Ethernet switches, in each LAN network.

iv. All other communication parameters shall be user configurable such as baud rate, parity and data bits.

v. Along with CRP panels, a separate Disturbance Record Control Analysis (DRCA) panel shall be considered by bidder which houses industrial PC, network switches, LIU etc. All the relays in the CRP shall be connected to the DRCA system through a network LIU, patch cords, switches etc. The DRCA system shall have a single software through with IEDs of all OEMs can be communicated for retrieving DR, settings parameterization and relay configuration. The DR retrieval shall be automatic, and frequency of DR retrieval shall be settable. All the DR shall be time sync with GPS clock. Bidder shall be responsible for Integration of new CRP with DRCA system at each station.

vi. Establishing communication between CRP relays upto DRCA system, through requisite communication cable and communication accessories is in bidder's scope. This will include supply, installation and testing of communication cable, accessories, local communication network (including fiber splicing) from relay panels to DRCA Panel and final Ethernet connectivity to DRCA system.

vii. Bidder to consider dedicated Relay port for integration with the DRCA system.

5.3.2. EXTENDED LOADING CAPABILITY

i. The relay shall retain in non-volatile memory even after DC on/off cycles.

ii. A sequence of events record consisting of the latest time-tagged events.

iii. Fault records with defined pre-& post trigger waveforms of voltage and current measurements, contact input and output status, and relay element conditions.

iv. The relay shall accept IRIG-B time code synchronization and include a battery-backed time clock to retain date and time during de-energization.

5.3.3. SOFTWARE FOR INTERFACES

User software shall be menu driven and shall be compatible with Windows 10 or higher operating system. Software version for all the IEDs shall be same. Using the software, the user shall be able to view and set the settings, configure the input & output relays and LED's, comparison between two sets of settings, create programmable logic scheme, view on line metering data, event log, download fault events, load files from PC to the relay and relay to PC, and print all settings. The software should allow selective access to various users based on the password used. The master user should be able to assign access of various functions to a user.

5.3.4. INPUT / OUTPUT

i. The IED shall support both 1A/5A CT secondary connections without changing the hardware. It shall be possible to change the CT secondary rating in parameter settings.

ii. The field input shall be wired to BI of the relay through high burden aux. relay to prevent mal operation on capacitive discharges in the control cables in the field. Galvanic isolation for field inputs.

iii. Adequate no of programmable output contacts. Output contacts rated for tripping duty as per IEEE C37.90 standards.

iv. All binary input, output, auxiliary relay contacts shall be wired up to TB irrespective of it is used or kept spare.

v. A relay healthy ALARM contact.

vi. Relay shall be preferably of modular design for quick replacement and shall have feature of extending I/O's.

vii. Trip LED indication for each protection function.

viii. PT Voltage inputs- Rated nominal voltage of 50 V AC to 140 V AC, 50 HZ. Shall withstand 240 V AC continuous and 360 V AC for 10 seconds.

ix. Current inputs – Rated nominal currents of 5A and/or 1 A at 50 HZ, shall withstand 2 x Ir continuous current and 100 x Ir for 1 sec.

5.3.5. POWER SUPPLY REQUIREMENT

The relay shall operate properly for 85 V AC/DC to 250 V AC/DC and shall withstand 315 V DC or 300 V AC for 1 sec. Rest all the accessories in the panel shall operate at -20% / +10% of rated supply continuously. Station wise AC/DC rated voltages are mentioned in the respective sections.

5.3.6. FEATURES FOR PROPOSED PROTECTION SYSTEM

The protection system shall be built on the latest technology and the bidder must guarantee for supply of spares for at least 15 years. Further the bidder should have full range of manufacture of the system offered.

Wide setting ranges with fine setting steps for each protection shall be available. Details of Protection features

A. Distance Relay Protection 21

The characteristic of Main protective system shall be directional quadrilateral. The maximum operating time of the scheme including carrier/FOP transmitting/receiving time shall not be greater than 25 milli second even during minimum generating condition. The setting range of the relay shall be continuously adjustable and should be suitable for the line data furnished. The relay shall have four forward zones and one reverse zone. The relay shall be able to detect load encroachment. The relay shall have power swing blocking, single and

three phase tripping and auto reclose features. The power swing blocking shall include choice of all standard/ Transfer trip modes available and the weak in feed tripping feature.

i. Curves showing variation of operating time for faults in different parts of first zone, especially as the fault position approaches the cut-off point shall be furnished. Operating curves for different source to line impedance ratings shall be furnished. The operating time for Zone 2, Zone 3, Zone 4 and reverse Zone shall be continuously and independently adjustable from 0 to 3 seconds.

ii. The maximum value of source impedance to line first zone setting impedance at which relays measure accurately shall be stated. The characteristic angle of the measuring element shall be continuously adjustable to match the line angle. Necessary adjustable compensation shall be provided for earth fault relay for correct measurement.

iii. The protection shall operate instantaneously (SOTF) when circuit breaker is closed on to any type of faults on line.

iv. The protection system offered shall be suitable to adopt PURCHASER's /Fibre optic communication system. Provision shall be made for receiving the FOP signal and tripping of the breaker. Carrier received annunciation shall also be provided. A carrier cut-off switch shall also be provided to make the carrier in-operative when required. Breaker failure protection commands shall trip remote end breaker by direct transfer trip through a separate channel distinct from the channel used for Main-I and Main-II protections.

v. The Scheme shall have suitable relay to prevent mal-operation of distance protection scheme in the event of VT secondary fuse blowing out.

vi. The distance scheme shall also incorporate necessary relay to energies auto-reclosing relays. Auto-reclosing of single pole on single pole tripping due to phase to ground faults shall be provided. Also, facility should be provided for Tripping and auto reclosing of three phases (after Synchro-check) for single phase to earth faults. A selector switch to make auto-reclosing scheme inoperative shall also be provided. Auto reclosure shall also be blocked when carrier is out of service.

vii. For line protection, all the line protection related signals viz. Carrier send, carrier receive, DT send, DT receive, Differential Intertrip, Differential Comm fail, Differential OUT, Earth switch ON status etc shall be routed through differential fibre. There shall be at least 6 digital channels available in differential relay for configuring these signals through differential fibre to remote end relay.

viii. Bidder to consider control cables for communication between relay panel and multiplexer panel along with services for terminating and testing.

B. Numerical FOP based Line Differential Protection 87L

i. The relay shall be used with optical fiber. All relay supplied shall be capable of 3 terminal line differential protection.

ii. Line Differential protection shall be a comparison type unit protection to detect phase and earth faults. As with all unit protection, Line differential scheme shall have an exactly defined zone of operation and tripping shall be without any intentional delay. Supervision facility for FOP shall be provided. The scheme shall not operate for the external faults.

iii. The interfacing equipment for FOP signalling system required by above scheme shall form a part of protection system itself. As these protections are offering unit protection, it is also required that the protection system offered shall include equipment for both ends of the line. The price quoted shall be for the complete system. The detailed cost break up for the system shall be furnished in the Bid.

iv. The scheme offered shall also be suitable for single phase tripping and reclose on phase to ground faults as in the case of distance protection. The BIDDER shall furnish technical particular of the system offered. Maximum operating time of protection shall be 25 milli second inclusive of carrier receipt and transmission.

v. In the absence of FOP, the line differential protection shall be capable of providing Dir. O/C protection the pickup of which can be adjustable.

vi. Line differential protection shall be made inoperative when the line is transferred on Transfer breaker.

vii. Line differential protection will be either on direct fibre Single mode or Multimode through Multiplexer as per the details given in Communication specification. The offered relay optical modules to support driving optical signal to the distance as given in the specification.

viii. Bidder to consider communication networking accessories such as fibre cables, termination boxes (LIUs), patch cords, conduits and termination services.

C. *Power Transformer / Reactor / ICT / Auto transformer Differential Protection 87T*

i. 87T shall be discrete relay having three winding biased differential for power transformer and 4 winding facility for ICT / Auto transformers.

ii. 87T shall be a biased differential protection and shall be provided with 2nd & 5th harmonic restraint feature.

iii. Transformer vector group and transformation ratio correction with different CT rated current (1A/5A) shall be settable inside the relays.

iv. The relay shall have facility to detect CT saturation and open CT with settable blocking facility.

D. Over fluxing Protection (24)

i. Over fluxing Protection: Over flux protection shall be provided based on Volts/Hertz measurement.

ii. Overfluxing protection shall take input from LV bus to which transformer is connected.

iii. Two definite – time and one selectable inverse time curve shall be provided. The inverse time element shall have a settable reset timer to account for thermal effects of repeated violation of the settings.

iv. The overexciting protection shall operate properly over a range of 20Hz to 60Hz.

E. High Impedance Differential Protection 64 REF for star winding

i. The high impedance 64 REF shall be provided with a suitable stabilizing resistor and protective metrosil arrangement. The stabilizing resistor shall be settable over a suitable range like rheostat and shall have sufficient wattage rating.

ii. This protection shall be provided phase wise in case of ICT, Reactors and auto transformers.

F. Numerical Directional Overcurrent & Earth Fault Protection (67 and 67N)

i. In addition to Main protection, feeders/lines shall be protected by back up protection numerical directional Numerical (IDMT) over-current relay and earth fault relays.

ii. It should derive zero sequence voltage and current internally for earth fault protection.

iii. It shall have a setting range of 50 to 200%. Relay shall have Directional O/C and earth fault feature. The relay characteristic angles shall be settable between 0 to 360 degrees for both phase and earth fault.

iv. The relay shall have all IEC/ANSI Characteristics with settable forward and reverse direction for all stages.

v. The relay shall also include a high set instantaneous over-current unit with a continuously adjustable setting range of 500-2000% of rated current. The relays shall have fault disturbance recording and remote communicating facility.

G. LBBU Protection (50Z)

LBBU protection shall be part of main protection. In such a case it should be possible to initiate the built-in LBB protection by external trip relay contacts.

i. LBBU shall be initiated by bay lockout relay and shall give trip signal to its own breaker and the breakers connected to the same bus, after predetermined time delay through busbar tripping relays.

ii. The LBB protection gives tripping command to bus bar tripping relay only after ensuring that Main or any other protection has already operated.

iii. The relay shall be three phase having an operating time less than 20 milli seconds. The setting range shall be 5 to 100% of rated current. A time delay with a continuously adjustable setting of 0.1 to 1 sec shall be provided

iv. The relay shall have a continuous thermal withstand capacity to carry two times rated current irrespective of the setting.

v. The Protection shall be suitably designed for 1-ph as well as 3-ph auto-reclosing.

vi. LBBU protection shall be provided with remotely operated IN/OUT command through IEC61850.

H. Numerical Non-Directional Over-current & Earth Fault Protection (50/51, 50/51N)

i. Three phase Numerical (IDMT) over-current relay and numerical (IDMT) earth fault relays shall be provided for phase over-current and earth fault protection.

ii. It shall have a setting range of 5 to 200%.

iii. The relay shall have all standard IEC/ANSI characteristics.

iv. The relay shall also include a high set instantaneous over-current unit with a continuously adjustable setting range of 500-2000% of rated current.

I. Numerical Bus Fault Protection

The bus bar arrangement will be as indicated in the respective single line diagram. The required bus bar differential scheme shall comprise of Numerical Bus Bar System for Z#1 and 2. The IED shall be configured accordingly. Also, the IED shall be suitable for incorporating all bays shown in respective SLD. Accordingly, trip relays with sufficient contacts to be provided bay wise.

The Bus bar protection IN/OUT shall have remote (IEC61850 command based) and local (Function key based) operating facility. Bus bar reset push button shall be illuminated type. End fault protection feature shall be provided.

The bus bar protection shall incorporate feature listed below.

i. Numerical Bus Fault Differential Relay (87B) Operating Principles:

High speed, low impedance, biased differential relay with percentage bias characteristics and an adjustable setting range of 20% to 100% of the rated current per zone shall be provided. Operating elements on all three phases for both the schemes shall be provided and they shall operate for phase to phase and phase to earth faults. The operating time of the relay at 2 times of the pick-up setting shall not be greater than 15 milli seconds. The relay shall remain stable for external fault conditions and shall not operate on transients. CT saturation due to internal faults and external faults shall not affect the performance of the scheme. The relay shall accept CTs with different ratios. Minimum 16 binary I/P and 16 binary output relays with separate +ve and –ve terminals are required. This relay shall not operate due to normal load flow in the bus bars.

ii. Bus Fault CT Secondary Wiring Supervision feature shall be provided in 87B:

Bus bar protection shall get blocked in case of open / short-circuit on the CT secondary circuit. The alarm for the same shall be provided.

iii. Supervision of Auxiliary DC Supplies:

Supervision scheme shall be provided to supervise of all auxiliary DC supplies and the Scheme shall initiate annunciation on DC supply failure.

J. Overload Trimming

An overload (directional) trimming feature shall be provided for each line and transformer bay. 04 nos. self-reset type trip relays for each bay with flag indication shall be provided for load shedding. The relay shall be capable of 3 out of 3 logic. Local (through function key) and remote (through IEC61850 command) operated IN/OUT shall be configured for OLTS scheme.

K. Under frequency relay

The relay shall have:

i. Minimum no of Setting Group: 04 no

ii. Minimum no of under frequency stages: 05 no.

iii. Minimum no of over frequency stages: 04 no.

iv. Minimum No of df/dt stages: 05 no.

Requirement of Load Shedding Scheme:

a. There should be two different settings during normal operation and islanded operation.

b. The settings shall change either automatically or from single SCADA command

c. Each stages should have dedicated IN / OUT facility with remote selection.

Auto Restoration Scheme:

The Requirement of Auto Restoration Scheme is as below:

a. Auto-restoration scheme is to be employed to arrest high frequency variations post islanding.

b. First auto-restoration scheme should restore the load then the settings of islanded mode shall change over to normal mode

c. The auto-restoration scheme will be active only for 60 Sec after islanding and it should restore the designated feeder only if that feeder is tripped on islanding.

d. The load restoration should restore the load on over frequency and rising df/dt together. The restoration should be on three different frequencies.

L. *Reverse Power Under frequency relay*

Both reverse power and under frequency shall operate simultaneously in one IED.

The relay shall have settings in terms of active / reactive power in primary kW / MW OR in secondary mW / Watts OR in % terms. Power angle shall be settable in degrees from 0 to 360 degrees with step of 1 degrees. The pickup setting step possible shall be 0.1% of rated power or lesser. The stage shall be selectively kept ON / OFF with binary input. Reverse power operate time delay shall be settable between 0.1 to 6000 sec with step of 0.1 sec.

Under frequency with fixed validation time window shall be settable with 45 Hz to 55 Hz window. The pickup step shall be 0.01 Hz. Under frequency operate time delay shall be settable between 0.1 to 6000 sec with step of 0.1 sec.

Total number of reverse power stages required = 04

Total number of under frequency stages required = 04

M. High Impedance bus fault protection 87HZ BB

i. In high impedance bus fault protection panel, links for phase wise CT summation for required number of bays shall be made available. CT summation shall be done in bus fault protection panel.

ii. The operating time of the IED at 2 times of the pick-up setting shall not be greater than 15 milli seconds.

iii. The relay shall remain stable for external fault conditions and shall not operate on transients. CT saturation due to internal faults and external faults shall not affect the performance of the scheme.

iv. The IED shall be capable of sensing phased wise bus fault with pickup current ranging from 5% to 100% of rated secondary current.

v. For Zone-1 & Zone-2, dedicated relays shall be used. Apart from busfault relay, one blind zone protection relay shall also be provided for protecting unprotected zone between bus section breaker and CT.

vi. The high impedance busfault protection shall be provided with phase wise variable stabilizing resistor and protective metrosil surge protection arrangement. The rating of stabilizing resistor shall be calculated based on CT details and station fault level with safety factor of 2.

vii. Bidder shall submit the stabilizing resistor and surge protection rating calculations for Tata Powers approval during detail engineering.

viii. The IED shall have internal functionality for supervision of open / short / saturated / abnormal CT and shall block the bus fault protection upon sensing it. The CT supervision alarm for the same shall be provided.

ix. Number of lockouts – Zone wise enough number of high speed (<5ms) latch type lockouts with suitable NO/NC contacts shall be provided. For each feeder at least 4NO & 1 NC contact shall be considered. Lockout supervision shall be provided for each of the bus fault lockouts.

N. General Requirements of Numerical Relay

Numerical relays shall have a data port for local access using a laptop / PC with Windows 10 or higher version software. The numerical relays of same OEM shall have common software version platform. Each relay shall have two dedicated inbuilt Fibre Optic (FO) port which can be used for SCADA applications and relay networking for downloading DR waveforms. The Communication protocol for SCADA shall be IEC61850 and it shall be capable to report with min. 5 clients.

Details of Numerical relay communication ports are as follows:

CommunicationFront: Ethernet port

Rear: Dedicated inbuilt Fibre Optic Port (FO) on IEC 61850 (for integration of relays for SCADA and integration with DRCA System local as well as central)

SNTP protocol support (from SCADA system) with Min.2 clients for Time synchronization.

O. General Relays

i. Lockout / Tripping Relays (86)

High speed tripping relays shall be provided for trip functions of various protection schemes. The operating time of the relay shall not be more than 10 ms. The pick-up value of the relay shall be in the range of 50 to 60% of rated voltage. Healthiness of the each tripping relays shall be supervised by suitable tripping relay supervision relay. It shall be

static type. The lockout reset type relays shall be provided with a local and remote reset facility. There should be an illuminated RESET pushbutton for local indication. The illumination lamp shall continuously withstand -20 to +10% rated DC voltage.

ii. Lockout supervision and Trip Circuit Supervision Relays (95)

Each bistable trip/lockout relay operate coil shall be supervised by a separate TSR relay. The TSR relay shall have 4NO contacts for annunciation. For trip circuit or breaker trip coil, pre-closing and post-closing breaker trip coil supervision shall be provided for all circuit breakers. One relay shall be provided for each trip coil and they shall be connected at the end of tripping loop. Action of the relay shall be annunciated. The relays shall have an inherent limit in time delay of 100 to 200 milli seconds to prevent operation due to transients. The relay shall operate satisfactorily for 80 to 110% of rated supply voltage. It shall be static type.

iii. DC Supply Supervision (80)

DC supply of each protection and alarm scheme shall be monitored by no volt relays. The relay on operation shall give annunciation.

Two DC feeders shall cater to DC power requirements for relay panel. Under normal circumstances, one set of trip circuits shall be supplied by one feeder and another set of trip circuit shall be supplied by the second feeder. For this purpose, two sets of DC busbars shall run for entire length of panels. Provision shall be made to feed the entire length of panel from one supply during outage of other supply by manual changeover. The BIDDER shall include the required equipment for the same.

iv. Carrier / Trip transfer relays:

Latched type bi-stable relays for Carrier, trip transfer, transfer breaker etc shall be provided. These shall have local as well as remote set / reset facility from SCADA. These relays shall have sufficient NO and NC contacts.

v. Automatic Self-Monitoring Facility:

The relay shall have continuous automatic self-monitoring and alarming facilities. The above feature shall not affect the relay availability i.e. when an actual fault occurs in the system during the checking cycle, the above cycle shall be immediately interrupted, and the relay shall check and respond to the system fault. The system shall have the following visual indications for supervision of each command channel.

a. Input activated at transmit end

b. Command transmitted

c. Command received

d. Equipment in local loop test

e. Equipment in remote loop test

f. Test pass

g. Test fail

h. General alarm

i. Equipment in synchronism

P. In-built Fault Distribution Recorder:

Disturbance record shall have 3 sec record time, 0.5 sec pre-fault and 10 memory record with internal/external triggering facility.

5.3.7. General Requirements for Relay Panels

Bidder shall supply standard panels of M/s Rittal make as per following specifications.

Sheet Metal Work

a. The panel frame shall be fabricated using suitable mild steel structural sections of pressed and shaped cold rolled sheet steel.

b. Thickness of material (CRCA) shall be 3 mm for load bearing members (front, base frame and gland plate) and 2 mm for non-load bearing members (Back, side, rear, top cover and bottom). Stiffeners shall be provided wherever necessary. The Panels shall be provided with MS Base frame Channel of 75 x 50 mm with anti-vibration pad.

c. All panel edges and door edges shall be reinforced against distortion by rolling, bidding or by the addition of welded reinforcement member.

d. Cut-Outs shall be without sharp edges.

e. The complete structure shall be rigid, self- supporting, free from vibration, twists and bends.

Constructional Features

The panel shall be

a. Of the metal enclosed indoor, floor mounted, Simplex type (W = 800 mm, D = 800 mm, H = 2300 mm) with single door for front with a separate glass door and double door (centre opening) rear opening. All the devices shall be mounted on internal swing door at the front.

b. Made up of the requisite vertical sections suitable to provide a degree of protection of not less than IP 54 as per IS: 2147 when control cabinets are specified for indoor use.

c. Of self-cooled design with adequate louvers on both back doors. The louvers shall have screens and filters on inner side of panel. The screens shall be of fine wire mesh made of brass or GI wire.

d. Provided with labels on the front and rear indicating the panel designation.

e. Provided with cable entry facilities and removable gland plates at required locations.

f. Provided with neoprene gaskets all-round the perimeter of covers, gland plates, removable covers and doors.

g. Safety earthing with Tinned copper earth bus of 150 sq.mm (25mmX6mm). Two Nos. earthing terminals shall be provided at each end of panel to connect PURCHASER's earthing conductor.

h. Simplex type panel shall incorporate operating devices only in the front

i. Strip type space heaters of adequate capacity shall be provided for each panel. Heaters shall be complete with rotary type Auto ON-OFF thermal switch, a single pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heaters at 45 deg C. The space heaters shall be covered with protective mesh. The panels shall have 240V, single phase, 50 Hz, 8 Watt LED light fixtures for interior illumination controlled by ON/OFF switches and 240V, 1 phase, 3 pin receptacles. Power source for interior lighting and receptacle shall be completely independent of control power source. LED type lamp shall be used for cubicle illumination.

j. Panel shall be designed in such a way that all component/ equipment's operate satisfactorily without exceeding their respective maximum permissible temperature rises under temperature conditions prevailing within the cubicles. Reference ambient temperature outside the switchgear cubicles is specified in the specifications.

k. Cable entries shall be from bottom. Suitable removable cable gland plate shall be provided on the cabinet for this purpose. Necessary number of cable glands shall be supplied/fitted on to this gland plate. Cable glands shall be screw-on type and made of brass.

l. Bottom and Gland plate details:

Bottom plate with two opening size 275 mm X 550 mm

Two gland plates of size 315 mm X 590 mm

m. All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside.

The paint shade for,

Exterior: shall be RAL7032, texture finish.

Interior: shall be White glossy finish

Base frame: Black semi glossy

Thickness: 80 Micron for powder coated

n. Each panel shall be provided with necessary arrangement for receiving, distributing, isolating and protection of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with MCBs. Supply monitoring arrangement shall be provided. Potential circuits for relaying and metering shall be protected by MCBs. MCBs shall have aux. contacts for monitoring.

Cabinet Internal Wiring

a. Control cabinets shall be supplied completely wired, ready for PURCHASER's external connections at the terminal blocks. Wiring shall be carried out with multi-stranded FRLS, 1100V grade PVC having oxygen index 29 and temp. index of 250 Deg. Wiring inside the panel shall be kept in plastic trays.

Following sizes of wires shall be used:

CT wiring	2.5 sq.mm	R / Y/ B / Black
PT Wiring	1.5 sq.mm	R / Y/ B / Black
DC wiring	1.5 sq.mm	Grey
1 ph. Ac wiring	1.5 sq.mm	R / Black
Ground	2.5 sq.mm	Green
Annunciation	1.5 sq.mm	Grey

b. All panel internal wires shall be connected at top of the TB. The bottom of the TB shall be left for field wiring. Enough depth and width of vertical and horizontal cable trays shall be provided considering bunch of external cable entry into panel. Cable tray lid shall properly close after routing field cables into panel. All wires terminated on relays and TBs shall be with sleeved ring type or 'O' type crimped lugs only.

c. Ferrules should be provided for wires. Ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is removed. Spare auxiliary contacts of the relays etc. shall be wired to terminal blocks. All wiring shall be terminated on terminal blocks using crimping type of tinned copper lugs. Insulated sleeves shall be neatly punched and cleaned without affecting access to equipment mounted within the cabinet. Wiring troughs shall be provided for vertical cabinet wiring and for interconnecting wiring between front and rear section of the cabinet.

d. 1.1 kV grade terminal blocks complete with insulated barriers, terminal studs, end plates, washers, nuts and locknuts and identification strips shall be used. All the terminal blocks shall be mounted horizontally (vertical mounting is not acceptable) on anodized channels at an angle to provide easy access at a height of minimum 300mm from the base. All the TBs shall be of disconnecting type, 1100 V Elmex make, 40 Amp, KLTDM4 type. Disconnecting TB rails shall be mounted horizontally in such a manner that when TB link is dropped, it falls due to gravity. At least 20% spare terminal blocks shall be provided in each group (X1, X2 etc). Terminal blocks for control indication etc. shall be suitable for connecting at least two conductors of PURCHASER's cable of following sizes:

i. Potential and control : 2.5 mm2 multistrand copper wire.

ii. CT circuits : 6 mm2 multistrand copper wire

e. Terminal blocks shall be numbered for identification and grouped according to function. Engraved white on black labels shall be provided on the terminal blocks, describing the function of the circuit. There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 100 mm. Terminal blocks shall be provided with transparent acrylic covers.

f. PURCHASER's external cable connections to the control cabinet will be carried out using 1.1 kV grade, stranded copper conductors, PVC insulated, PVC sheathed, armored and PVC jacketed cables. All necessary cable terminating accessories such as packing glands,

crimp type tinned copper lugs, supporting clamps and brackets, etc. for PURCHASER's cables shall be included in Vendor's scope of supply.

g. For equipment supplied / to be supplied by the PURCHASER, the bidders shall provide suitable cutouts and wiring shall be done up to the terminal blocks as per purchasers requirement.

Labels

All door mounted equipment as well as equipment mounted inside the control cabinets shall be provided with individual labels with equipment designation engraved. Also the control cabinet shall be provided on the front with a label engraved with designation of the control cabinet as furnished by PURCHASER. Labels shall be made of non-rusting metal. Labels shall have white letters on black or dark blue background. Sizes of labels and lettering are subject to PURCHASER's approval.

Earthing Terminals

a. Each control cabinet shall be provided with two separate earthing terminals suitable to receive PURCHASER's earthing conductors of size specified.

b. Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wire/bars bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

c. All instrument and relay case shall be connected to the earth busbar using 1100 grade PVC insulated 2.5 sq.mm stranded tinned copper earthing conductor.

d. All hinged doors shall be positively connected to the earthing bus terminals, with the help of braided copper conductors of adequate size.

e. All the earth connections to earth busbar shall be nut bolt type with washer. Screw type connection is not acceptable.

6. LAYOUT REQUIREMENTS OF EQUIPMENT

5.1 The relay panels shall be designed for keeping it adjacent to each other. All the inter panel wiring, FO cables etc shall be facilitated from inside the panel with a proper rectangular cutout at the top side location. The cutout edges shall be properly insulated so that the edges do not damage the cables. The cables shall be bunched together with a PVC spiral guard.

5.2 The copper tinned earth strip of 25 x 6 mm size in each panel shall be located at the bottom of the panel. It shall have arrangement to connect with adjacent panels with the same dimension material strip on both sides. A suitable cutout shall be made at both sides of panel to make the earth busbar continuous.

5.3 Station specific layout arrangement is mentioned in the respective sections.

7. SAFETY AND OPERATIONAL REQUIREMENTS

7.1 Safety Requirements

All equipment, system and services covered under this specification shall comply with all latest applicable statutory regulations and safety codes in the locality where the Equipment is proposed to be installed. All equipments supplied shall conform to following electrical safety tests as per IEC 61010-1

> Single fault condition assessment

> Earth bonding impedance test Mechanical resistance to shock and Impact

> Rigidity test

> Impact hammer test

> Protection against electrical shock Protection against the spread of fire

7.2 Performance Requirements

The performance test of complete Protection Panel installation under this specification shall be carried out at site as required to demonstrate the guarantees.

Purchaser will participate in all performance tests. The Bidder shall notify the performance test schedule two weeks in advance before carrying out the tests.

7.3 The performance test requirements are as follows:

Commissioning Tests

Trial operations and simulations

7.4 Any special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Bidder.

7.5 The Bidder shall prepare all test reports, in which the methods followed, instrument readings, graphs, observations, results obtained etc. shall be recorded. Duly signed detailed report shall be submitted to Purchaser's approval within one week time.

7.6 In case of performance test results deviate from the guaranteed values including the specified tolerance, the Bidder shall correct his equipment at no extra cost and repeat the performance tests. Purchase may retain the option of rejecting the equipment, and in the case of such option of rejection being exercised, the Bidder shall replace the entire equipment with new one which will meet the guaranteed parameters.

7.7 PERFORMANCE & GUARANTEE TESTS

7.8 Combined Protection, Automation and Communication Factory Acceptance Test (FAT) shall be carried by Vendor at factory in presence of Inspection Engineer.

7.9 During FAT all the panels, relays, schemes etc shall be 100% tested, simulated and checked. It will be 100% FAT for all the panels. Bidder shall provide sufficient resources during FAT.

7.10 Routine tests shall be carried out on all associated equipment as per relevant Indian Standards. Protection Panels shall be subjected to following tests:

a. Routine Tests:

b. High Voltage test (2000 Volts for 1 minute)

c. Detailed Testing of all IEDs, detailed scheme checks during factory inspection with approved configuration and load service settings.

d. Verification of wiring as per approved schematic drawings.

e. Type Tests:

7.11 Certified copies of all type test reports as per Indian Standards shall be submitted for approval before technical discussion.

a. Type Test report for IEDs

b. Temperature rise test on power circuits

c. Short time current tests on power circuits.

d. Mechanical Operation (Vibration) test.

e. Verification of the degree of protection as per IS: 2147.

8 GUARANTEED TECHNICAL PARAMETERS OF EQUIPMENT INCLUDING DATA SHEET

Sl. No.	Description	Tata Power requirement	Bidder compliance
(I)	**Relay Panels - General**		
1.	Type of Panel (Simplex) with front and rear opening	Yes	
2.	Applicable Standard IS /IEC	IS:2147	
3.	Sheet Steel (Hot Rolled / Cold Rolled)	Cold Rolled	
4.	Thickness of Sheet Steel		
a.	Base (in mm)	MS frame 3mm width and 75 x 50 mm size	
b.	Sides & Tops (in mm)	2mm	
c.	Front and Rear (in mm)	3mm	
d.	Base Channel Provided (Yes / No)	Yes	
e.	Anti-vibration pad provided	Yes	
5.	Degree of Protection Provided	IP54	
6.	Cable Entry (Bottom /Top)	Bottom	
7.	Thickness of Gland Plates (in mm)	3mm	
8.	Accessories Provided (Yes / No)		
a.	MCB for controlling 240 V AC of Panel	Yes	
b.	Cubicle Space Heater with Thermostat	Yes	
c.	Plug Point with ON-OFF switch	Yes	
d.	LED Lightening Fixture with cover and ON-OFF Lighting switch	Yes	
e.	Nameplates front and rear	Yes	
f.	Acrylic labels for each equipment	Yes	
g.	Overall Dimensions of each Panel (L x D x W)	800 x 800 x 2300	
9.	Earthing Bus Material & Size	Tinned Copper 150 sqmm (25x6 mm)	
10.	Painting		

Sl. No.	Description	Tata Power requirement	Bidder compliance
a.	Method of Painting	Metal Degreased Pickled Phosphated with two coats of each zinc chromate primer and synthetic enamel paint	
b.	Exterior Shade of Paint	RAL7032 Texture finish	
c.	Interior shade of Paint	White Glossy finish	
d.	Base frame shade of Paint	Black semi glossy	
e.	Thickness of paint	80-micron powder coated	
11.	Design Ambient Temperature	50 deg C	
12.	Terminal Blocks		
a.	Make & Model	Elmex KLTDM4	
b.	Disconnecting type which falls with gravity	Yes	
c.	Voltage and Current rating	1.1 kV, 40 A	
d.	Molded inter-terminal barriers provided (Yes / No)	Yes	
e.	Max. conductor size & no. of conductors which each terminal can receive	Two	
f.	Terminal Numbering provided (Yes / No)	Yes	
g.	20% spare terminal provided in each panel each group (Group is X1, X2 etc)	Yes	
13.	Proper cutout provided at top of the panel with proper protection at all edges	Yes	
14.	Internal Panel Wiring	Yes	
a.	Multi-strand copper wires provided (Yes / No)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
b.	Size & Color of CT wiring	2.5 sqmm R/Y/B/Black phase wise	
c.	Size & Color of PT wiring	1.5 sqmm R/Y/B/Black phase wise	
d.	Size & Color of DC Wiring	1.5 sqmm Grey	
e.	Size & Color of Annunciation Wiring	1.5 sqmm Grey	
f.	Size & Color of Earthing Wiring	2.5 sqmm Green	
15.	Control Voltage (in Volts)	As per station details in relevant sections	
16.	IED make shall be any of the three Vendors: ABB 650 (except REL650) and 670 series, GE (MICOM series 40 and above) and SIEMENS (Siprotec Series) (YES/NO)	Yes	
17.	Substation Protection, automation and communication Vendor shall be one only. Bidders for the package shall be: ABB, SIEMENS and GE (YES/NO)	Yes	
18.	Each of the numerical relay has at least 5 nos of user configurable function keys	Yes	
19.	Each of the numerical relay has 20 nos of memory-based user configurable Set-Reset Flip Flops	Yes	
20.	Relay is capable of taking soft pulse type commands through IEC61850 for IN/OUT functionality	Yes	
21.	Louvers with wire mesh protection are provided on back doors of CRP	Yes	
22.	Trip relays and Auxiliary relay shall be ABB or GE make only (YES/NO)	Yes	
	Relay Panels – Specific		
A.	**110 / 220 kV LINE or TRANSFER BREAKER CRP panels**		

Sl. No.	Description	Tata Power requirement	Bidder compliance
a.	No. of Relay Panels per bay	2 nos	
b.	IED-1 and IED-2 of different OEM provided as per Table-1 specs. (Yes/No)	Yes	
c.	For 3-terminal lines, both Main-1 & 2 IED are capable of 3 terminal line differential protection (Yes/No)	Yes	
d.	For two terminal line, modular type of relay provided which can be converted into 3-terminal relay with additional software/hardware	Yes	
e.	Numerical IED-1 with TYPE-A Table-1 function's (Mention Relay Model / Order code / MLFB No and quantity)	Bidder to mention	
f.	Numerical IED-2 TYPE-A Table-1 function's (Mention Relay Model / Order code / MLFB No and quantity)	Bidder to mention	
g.	Wherever specified, the bidder is ready to match IED-1 & 2 with lines remote end IEDs	Yes	
h.	2 nos (11NO/3NC) Fast acting (<10 ms) Latched type trip relay + TSR + illuminated PB etc. (Mention Type of relay, Make & Model number,)	Bidder to mention	
i.	12 nos (6NO) Fast acting (<10 ms), flag type Single phase trip relays for Main 1 & 2 for single phase Auto reclosure requirement (Yes/No)	Bidder to mention	
j.	OLTS trip relay (02 nos woth 14NO each) (Mention Make, model of aux relay)	Bidder to mention	
k.	Self reset type Direct trip send and Direct trip receive aux. relays (Per bay 2 set) (Mention Make, model of aux relay)	Bidder to mention	
l.	Control switch (TNC) for Breaker close open operation (Per bay 1 set)	Yes	
m.	Breaker status Close Red lamp & breaker Open Green lamp provided for each bay	Yes	
n.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
o.	Bkr TC-1 and 2 pre and post close supervision relay (Per bay 2 set)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
p.	Bus PT Selection relay scheme (Per bay 1 set)	Yes	
q.	DC selector (Source-1/2/Independent) switch provided (Yes / No) (Per bay 1 set)	Yes	
r.	Bay Own / Transfer aux relay for transferring DTS/DTR, CS/CR etc (Per bay 2 set)	Yes	
s.	MFM meter of SATEC PM130EH Plus provided (Per bay 02 nos)	Yes	
t.	Transfer breaker bay relays are considered with 06 nos of setting groups	Yes	
B.	**110/220 kV Bus Coupler / Bus section CRP panels**		
a.	No. of Relay Panels for Bus Coupler bay	1 No	
b.	1 no. IED provided as per Table-1 specs (Yes/No)	Yes	
c.	IED with TYPE-B Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
d.	01 number Fast acting (<10 ms) Latched type trip relay + TSR + illuminated PB etc. (Mention Type of relay, Make & Model number)	Bidder to mention	
e.	Control switch (TNC) for Breaker close open operation (Per bay 1 set)	Yes	
f.	Breaker status Close Red lamp & breaker Open Green lamp provided for each bay	Yes	
g.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
h.	Bkr TC-1 and 2 pre and post close supervision relay (Per bay 2 set)	Yes	
i.	Bus PT Selection relay scheme (Per bay 1 set)	Yes	
j.	DC selector (Source-1/2/Independent) switch provided (Yes / No) (Per bay 1 set)	Yes	
k.	MFM meter of SATEC PM130EH Plus provided (Per bay 02 nos)	Yes	
C.	**220-110/33 kV Auto Transformer / ICT CRP panel**		
a.	No. of Relay Panels for per AT/ICT (2 nos.)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
b.	IED-1, 2, 3 & 4 are provided as per Table-1 specs	Yes	
c.	IED 1 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
d.	IED 2 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
e.	IED 3 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
f.	IED 4 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
g.	06 nos (11NO/3NC) Fast acting (<10 ms) Latched type Trip relays for Gr 186 (110 kV), 286 (220 kV), 86 (LV-1) and 86 (LV-2) + TSR + illuminated Reset PB (Mention Relay make, Model, order code)	Bidder to mention	
h.	25 nos (4NO) Self reset flag type Alarm relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
i.	20 nos (8NO) High burden, Self reset flag type Fast acting (<10 ms) Trip relay relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
j.	Control switch (TNC) for Breaker close open operation (one per breaker)	Yes	
k.	Breaker status Close Red lamp & breaker Open Green lamp provided for each breaker	Yes	
l.	OLTS trip relay (04 nos.) (Mention Make, model of aux relay)	Bidder to mention	
m.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
n.	Bkr TC-1 and 2 pre and post close supervision relay (Per breaker 2 x 3 = 6 set)	Yes	
o.	Bay Own / Transfer aux relay for transferring trip and related signals (Per bay 2 set)	Yes	
p.	MFM meter of SATEC PM130EH Plus provided (Per breaker 01 nos)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
D.	**110/33, 110/22 kV Power Transformer (with one or two LV windings) CRP panel**		
a.	No. of Relay Panels for per Transformer	2 nos	
b.	IED-1 & 2 of different make provided as per Table-1 TYPE-D specs. (Yes/No)	Yes	
c.	IED-3 of provided as per Table-1 TYPE-D specs.	Yes	
d.	IED 1 as per TYPE-D Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
e.	IED 2 as per TYPE-D Table-1 functions (Note: Even if the specific transformer has only one LV breaker, bidder shall provide LV-2 related protection for future expansion)	Bidder to mention	
f.	Both IEDs can be readily used as 3-winding differential relay	Yes	
g.	IED 3 as per TYPE-D Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
h.	4 nos (11NO/3NC) Fast acting (<10 ms) Latched type Trip relays for Gr A, B, LV-1 & 2 + TSR + illuminated reset PB etc (Mention Relay Model, order code)	Bidder to mention	
i.	20 nos (4NO) Self reset flag type Alarm relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
j.	20 nos (8NO) High burden Self reset flag type Fast acting (<10 ms) Trip relay relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
k.	Control switch (TNC) for Breaker close open operation (Per bay 3 set)	Yes	
l.	Breaker status Close Red lamp & breaker Open Green lamp provided for each breaker	Yes	
m.	2 nos (14NO) OLTS trip relay (Mention Make, model of aux relay)	Bidder to mention	
n.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
o.	Bkr TC-1 and 2 pre and post close supervision relay (Per breaker 2 x 3 = 6 set)	Yes	
p.	Bay Own / Transfer aux relay for transferring trip and related signals (Per bay 2 set)	Yes	
q.	MFM meter of SATEC PM130EH Plus provided (Per breaker 01 no)	Yes	
E.	**110kV or 220kV Reactor**		
a.	No. of Relay Panels for per Reactor	2 nos	
b.	IED-1 & 2 of different make provided as per Table-1 TYPE-I specs. (Yes/No)	Yes	
c.	IED 1 as per TYPE-I Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
d.	IED 2 as per TYPE-I Table-1 functions (Mention Relay Model / Order code / MLFB No)	Bidder to mention	
e.	4 nos (11NO/3NC) Fast acting (<10 ms) Latched type Trip relays for Gr A, B + TSR + illuminated reset PB etc (Mention Relay Model, order code)	Bidder to mention	
f.	20 nos (4NO) Self reset flag type Alarm relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
g.	20 nos (8NO) High burden Self reset flag type Fast acting (<10 ms) Trip relay relays for Transformer device trouble (Mention Relay make, Model, order code)	Bidder to mention	
h.	Control switch (TNC) for Breaker close open operation	Yes	
i.	Breaker status Close Red lamp & breaker Open Green lamp provided for each breaker	Yes	
j.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
k.	Bkr TC-1 and 2 pre and post close supervision relay (Per breaker 2 x 3 = 6 set)	Yes	
l.	Bay Own / Transfer aux relay for transferring trip and related signals	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
m.	MFM meter of SATEC PM130EH Plus provided	Yes	
F.	**110 / 220 kV GIS Bus Bar Protection**		
a.	Low Impedance biased differential Type (Yes /No)	Yes	
b.	IED provided as per Table-1 TYPE-E specs (Yes/No)	Yes	
c.	Busbar relay with number of bays shown in respective SLD + additional 4 spare bays considered for each bus differential application (Yes / No)	Yes	
d.	No. of Relay Panels	2	
e.	IED Details (Mention Relay Model / MLFB No / order code)	Bidder to mention	
f.	Centralized or Distributed	Bidder to mention	
g.	End fault Protection feature with Auxiliary relays provided	Yes	
h.	LBBU function with externally trigger through BI provided	Yes	
i.	(Number of bays shown in SLD + 4 additional) (11NO/3NC) Fast acting (<10 ms) Latched type trip relays with + TSR + illuminated reset PB (Per bay 1 sets)	Yes	
j.	Suitable quantity, SCADA and manual operated bay zone selection scheme (Bay in Zone-1 or 2 or continuous zone) at appropriate stations necessary for scheme completion are provided	Yes	
k.	CT supervision operated lamp with reset push button provided for each zone	Yes	
l.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
G.	**110 / 220 kV AIS Bus Bar Protection**		
a.	Both Scheme-1 & 2 are based on low Impedance biased differential protection (Yes /No)	Yes	
b.	Scheme-1 & 2 with different make provided as per Table-1 TYPE-F specs (Yes/No)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
c.	Each Busbar relay with number of bays shown in respective SLD + additional 4 spare bays considered for application (Yes / No)	Yes	
d.	No. of Relay Panels (2 nos for Scheme-1 with related aux/trip relays and 2 nos for Scheme-2 and related aux/trip relays)	4	
e.	Scheme-1 IEDs as per TYPE-F Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
f.	Scheme-2 IEDs as per TYPE-F Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
g.	Scheme-1 IEDs Centralized or Distributed	Bidder to mention	
h.	Scheme-2 IEDs Centralized or Distributed	Bidder to mention	
i.	End fault Protection feature with Auxiliary relays provided for both IED-1 & 2	Yes	
j.	LBBU function with externally trigger through BI provided in each IED-1 & 2	Yes	
k.	For Scheme-1: Per bay 1 set (11NO/3NC) Fast acting (<10 ms) Latched type trip relays with + TSR + illuminated reset PB	Yes	
l.	For Scheme-2: Per bay 1 set (11NO/3NC) Fast acting (<10 ms) Latched type trip relays with + TSR + illuminated reset PB	Yes	
m.	Suitable quantity, SCADA and manual operated bay zone selection scheme (Bay in Zone-1 or 2 or continuous zone) at appropriate stations necessary for scheme completion are provided	Yes	
n.	CT supervision operated lamp with reset push button provided for each zone each IED	Yes	
o.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
H.	**Under Frequency Load Shedding Scheme CRP panel**		

Sl. No.	Description	Tata Power requirement	Bidder compliance
a.	No. of Relay Panels (1 no)	1 no	
b.	No. of protection IEDs for UFLS offered	1	
c.	IED provided as per TYPE-G Table-1 spec (Yes/No)	Yes	
d.	IED with TYPE-G Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
e.	No. of Trip relays offered (08 nos high burden, self-reset, flag type RXMH2 or Equivalent 6NO each) Shall be self-reset type	Yes	
f.	Auto restoration scheme as given in the specs considered (Yes/No)	Yes	
g.	DC supervision relay (1 no. per MCB group)	Yes	
I.	**110/220 kV Reverse power under frequency CRP panel**		
a.	No. of Relay Panels	2 no	
b.	IED-1 & 2 offered as per TYPE-H Table-1 specs	Yes	
c.	IED-1 with TYPE-H Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
d.	IED-2 with TYPE-H Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
e.	Latched type trip relay (4 nos) with 14 contacts + TSR + illuminated reset PB	Yes	
f.	DC supervision relay (1 no. per MCB group)	Yes	
J.	**High impedance bus fault protection**		
a.	No. of Relay Panels	2 no	
b.	Number of IEDs (Zone-1, 2 & Bind zone)	03 nos	
c.	Scheme has considered each Busbar relay with number of bays shown in respective SLD + additional 4 nos spare bays	Yes	
d.	Zone-1 IEDs as per TYPE-J Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
e.	Zone-2 IEDs as per TYPE-J Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	

Sl. No.	Description	Tata Power requirement	Bidder compliance
f.	Blind zone IEDs as per TYPE-J Table-1 functions (Mention Relay Model / MLFB No / order code)	Bidder to mention	
g.	CT supervision operated lamp with reset push button provided for each zone each IED	Yes	
h.	DC supervision relay Provided (1 no. Per MCB group set)	Yes	
i.	Suitable number of lockouts are provided (4NO+1NC per feeder)	Yes	
j.	Variable stabilizing resistor range considered as per specs	Yes	
(III)	**Other**		
1.	Warranty for 5 Years from supply of material (including IEDs, Trip and Auxiliary relays) (Yes/No)	Yes	
2.	Any additional number of IEDs, Aux relays etc for proper completion of scheme is considered by bidder during bid stage itself	Yes	
3.	Offer given as per specification and datasheet for CRP panel System and no deviation taken (Yes/No).	Bidder to mention	
4.	Protection Panel integrated FAT for 100% of panels shall be carried out with approved relay configuration and load service relay setting. (Yes/No)	Yes	
5.	3 terminal line differential 87L protection Communication architecture with BOM considered for all 220 / 110 kV lines (Yes/No)	Yes	
6.	DRCA system with industrial PC and its related accessories, LIU, switches, patch cords etc as mentioned in Automation specs considered per station	Yes	
7.	Type Test Report Submitted for all IEDs (Yes/No)	Yes	
8.	Bidder Meets Qualification Requirement given in Specs (Yes/No)	Bidder to mention	
9.	Preferred Vendor List: Deviation taken (Yes/No)	Bidder to mention	

Sl. No.	Description	Tata Power requirement	Bidder compliance
10.	One Laptop per substation: HP make, 8GB RAM, 1TB Hard disk, Core i5, 2 USB ports, 1 HDMI port, 9-pin serial port along with standard accessories and laptop carrying bag (1 number per receiving station)	Yes	
11.	All relay software's along with relevant data models, Gera types and connectivity packages are pre-installed in the laptop	Yes	
12.	In case of licensed software, bidder agrees to provide at least 10 nos of licenses or as many number of IEDs whichever is higher for purchasers use	Yes	
(IV)	**Spares**		
1.	01 nos of each type, model number, order code, MLFB IED per substation as lose spare relay shall be supplied	Bidder agrees	
2.	2 nos per substation, high speed (11NO/3NC) (<10 ms) latched type lockout + TSR + Push button shall be supplied	Bidder agrees	
3.	2 nos per substation of high speed (4NO) (<10ms), flag type self-reset type relay shall be supplied	Bidder agrees	
4.	2 nos per substation of transformer trouble alarm flag type relays (4NO) shall be supplied	Bidder agrees	
5.	2 nos per substation trip coil supervision relays shall be supplied	Bidder agrees	
6.	2 nos per substation of transformer trouble trip high burden relays (8NO), flag type shall be supplied	Bidder agrees	
7.	2 nos per substation of OLTS trip (14NO) type relays shall be supplied	Bidder agrees	
8.	2 nos per substation of TNC switches shall be supplied	Bidder agrees	
9.	01 number per substation of PT selector switch scheme set shall be supplied	Bidder agrees	
10.	2+2 nos per substation RED & GREEN lamps for breaker status monitoring shall be provided	Bidder agrees	

Sl. No.	Description	Tata Power requirement	Bidder compliance
11.	1 nos per substation of SATEC make 130EH Plus model meter shall be supplied	Bidder agrees	

9 QUALITY REQUIREMENTS (QAP & SQP)

9.1 To ensure that a well-engineered and contractually compliant system is produced, **Bidder shall adhere to Approved Tata power SQP** for the preparation of all contract deliverables. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies.

9.2 QUALITY REQUIREMENTS: Bidder to prepare and submit Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) for approval of Owner to ensure that a well-engineered and contractually compliant system is produced. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies.

9.3 Tata Power Standard Quality Plan (SQP) and Field Quality Plan (SFP) are attached with this specification defining minimum inspection and testing requirements during shop and site inspection respectively. Bidder to ensure that these requirements are compiled in MQP and FQP submitted for approval.

Factory Acceptance Test (FAT)

a) The FAT at factory shall be done with simulation, testing of relays, scheme checks on 100% of panels including automation and communication products. The vendor shall provide enough resources if owner sends more than one team for simultaneous inspection of number of panels.

b) Owner approved MQP shall be referred for shop inspection. The purpose is to ensure that the Bidder has interpreted the specified requirements correctly and that the FAT

includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab.

c) The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. Prior to release for shipment of the equipment the Purchaser or his representative will witness Factory Acceptance Test (FAT) in which the system is checked against the specifications.

d) Type and routine tests certificates shall be furnished. Tests for components shall be as per relevant standard specifications and approved MQP.

e) System tests shall be performed on the completely assembled system. Type, routine and optional tests covered in the approved MQP and this specification shall be conducted in addition to the system tests.

f) Bidder shall incorporate all FAT comments prior to despatch. After Bidder confirms that all changes have been incorporated, Purchaser's Office will issue Despatch Clearance.

g) The Test Reports as well as Test Certificates of OEM, third party, Bidder shall be submitted for approval / verification.

h) FAT and Despatch Clearance by the Purchaser shall not relieve the Bidder from complete responsibility for the total system and its performance subsequently.

10 INSPECTION, TESTING AND PERFORMANCE REQUIREMENTS ALONG WITH WARRANTY

a) Bidder should follow owner approved MQP and specification requirements.

b) All type test reports of IEDs, aux relays and all equipment's installed in CRP panel as per IEC & IS standards mentioned specs in the shall be submitted for purchaser review along with technical bid.

Performance Guarantee Parameters

a) Satisfactory operation of the system offered shall be guaranteed for 5 years from the date of taking over of system by purchaser after SAT including trouble-free & intervention-free operation.

b) Bidder shall undertake to repair or replace any part, which is defective or unequal to the rated duties due to faulty materials, design or workmanship.

Warranty

a) Bidder shall warrant that the equipment hardware is free of defects in material and workmanship or faults in design, in so far as the equipment fails to meet the requirements of this technical specification, for a period of 60 months from the date of final acceptance by the purchaser after completion of 30 days trouble free operation.

b) With respect to defects in equipment part, Bidder's liability is to make good by replacing the faulty equipment. It is the responsibility of the Bidder to replace the faulty equipment within 30 working days.

c) The Bidder will cover the cost associated with the shipping of defective or failed items during warranty period. The new equipment, parts shall be delivered free of charge.

d) Bidder shall extend all warranties / guarantees to the purchaser, provided by sub-Vendors, of duration longer than that in this specification

11 MANDATORY SPARES

Bidder to provide substation wise list of Mandatory spares required for trouble free operation of CRP panels, if any.

12 TOOLS AND TACKLES

Bidder to provide relevant tools and tackles for condition monitoring / maintenance of CRP panels, if any.

13 DATA SUBMISSION BY BIDDER

12.1 Tender Purpose

Bidder shall submit the following information along with the Technical Bid of Sub-Station Protection and Automation Specific Submissions

12.1.1 Bidder shall provide the technical offer including data sheets, architecture etc., of hardcopies and soft copies for the technical evaluation. All datasheets of the BOM items shall be enclosed along with the technical offer. **In absence of technical data sheet, architecture drawing, detailed bill of material, detail GTP etc, the offer submitted by the bidder may not be considered.**

12.1.2 Dully filled in schedules, listed in section 'C'.

12.1.3 Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

12.1.4 System Architecture Drawing

12.1.5 Catalogues of the equipment's offered

12.1.6 The attached Bill of Materials (BOM) and datasheets enclosed with the specification are indicative. The Bidders are expected to submit the detailed BOM mentioning the quantity, make, model and warranty.

12.1.7 Product life cycle document for all supplied equipment.

12.1.8 Confirmation on lifetime, spares, manufacturing, onsite & Offsite technical support of the supplied equipment for the next 15 years

12.1.9 List of major relevant experiences of the Principal, Collaborator and the Product respectively.

12.1.10 Technical support facilities including qualified man-power, testing tools and instruments and integration facilities available within India.

12.1.11 The Bidder shall give an undertaking to provide full range of local services (including hardware and software maintenance, modifications and upgrade support) for the life of the delivered Sub-Station Automation system including Communication interfaces.

12.1.12 Bidder to submit all relevant test certificates for evaluation

12.2 After award of Contract

The following documents shall be submitted for Purchaser's approval during detailed engineering through Wrench system (Web based system of TATA Power). All drawings will

be reviewed, commented and approved by TATA Power through Wrench system. Bidder shall nominate document manager for this activity and TATA Power will provide training on the same.

12.2.1 System Architecture Drawing

a. Network connections

b. Protocol used

c. Type of interconnecting cable

d. All IED's, workstations, gateways, network switches, etc.

12.2.2 Panel GA and Complete wiring diagram along with Trip matrix

12.2.3 Finalization of relay settings and configuration in consultation with Tata Power representative as per approved drawing and scheme

12.2.4 Detail Bill of Material listing; equipment designation, make, type ratings, etc. of all the equipment's supplied

12.2.5 Hardware and Software Specification & Manuals for all the equipment supplied including that of Third parties

12.2.6 Functional Design Document, Guaranteed technical, availability and reliability parameters

12.2.7 FAT & SAT procedures

12.2.8 DRCA I/O List as configured with address details

12.2.9 Interconnection Schedule (ICS) - Protection, Automation and Communication

12.2.10 All interoperability tables

12.2.11 Calculation for power supply, fuses/MCB, stabilizing resistors etc.

12.2.12 Logic Diagram (Hardware & Software)

12.2.13 Technical / Operator's Manual

12.2.14 IP addressing chart for all the IED's, network switches which are connected to the network

12.2.15 Other documents as may be required / applicable during detailed engineering

12.2.16 All drawings and data shall be annotated in English.

12.2.17 Bidder shall furnish four (4) hardcopies (plus 3 soft copies on reliable media) of all drawings along with manuals (Administration, Operation & Maintenance, Troubleshooting and Installation), Technical catalogues, Test Certificates and Acceptance Test Reports along with delivery.

12.2.18 Two copies of the internal test report, FAT and SAT documents with test protocol formats shall be submitted for approval. Approved FAT and SAT documents are one of the prerequisites of commencement of FAT and SAT. Bidder shall also furnish Original plus one copy of all System Software (OS and standard RTU/Gateway and other related software) along with delivery.

12.2.19 Bidder shall submit the final as built drawings & documents on AutoCAD & PDF format.

12.2.20 All licenses shall be valid for the entire lifecycle of the system supplied.

12.2.21 This list is indicative and will be finalized post award before the start of detailed engineering as MDL (Master Document List).

Annexure-1

Bidders Prequalifiying Requirements for Protection, Automation & Communication System

S No	Parameter	Tata Power Requirement	Documents To be submitted by Vendor to ascetrain meeting of Pre-qualification requirement
1	2	3	4
1	Infrastructure	Bidder must be an OEM of Protection relays, Sub-station Automation and Communication system, having manufacturing facility / assembly in India.	Self-undertaking to be submitted in this regard. Tata Power reserves the right to inspect the said manufacturing facility as a proof of compliance to this parameter.
2	Supply and Experience	The bidder should have supplied minimum 20 nos. Protection, Automation and Communication systems for 110 kV and above sub-stations with at least 10,000 Input-Output Points (of Gateways) for each project. The system supplied should have been in satisfactory commercial operation for a minimum period of 05 years as on scheduled date of the bid opening. Bidder shall offer latest software on open architecture and should have supplied these at least for 5 projects in last 2 years. Protection and Sub-Station Automation must be from the same OEMs. Indian Subsidiaries of global companies having plant in India are also eligible to bid if the qualification requirements stated above are met independently or in combination with the parent company. Declaration from parent company needs to be submitted.	Supply List & Performance Certificates from the utilities / clients Self-undertaking to be submitted in this regard. TATA Power reserves the right to inspect the said manufacturing facility as a proof of compliance to this parameter.
3	Type Test	The bidder shall submit Type test reports obtained from NABL/ International Accredited Lab for the equipment / material offered. The type tests should have been conducted on the equipment / material of the same design. The type tests should have been conducted within 5 years prior to the date of bid opening. Time period for type test may be extended by another 5 years as a special case, if there is no change in design / material of construction (MOC). In case the type test reports furnished are not for the quoted equipment / material but for the equipment / material with higher voltage class and/or different capacity, then type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material.	Type Test Report. Undertaking that there is no change in design / material of construction (MOC) if Type Test Report older than 5 years but less than 10 years prior to date of bid opening has to be considered (if applicable) Undertaking that type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material, in case type test reports furnished are not for the quoted equipment / material but for the equipment / material with higher voltage class and/or different capacity, (if applicable)
4	Commercial Capability		›py of audited Balance Sheet and P&L Account to be submitted in s regard.
5	EPC Experience (If applicable)	In case the package involves installation & commissioning of the equipment / material, then the bidder shall have the following experience: a) He should have successfully completed one single order of value ..... (80% of estimated value of similar work in last three years) OR b) He should have successfully completed two single orders of value ..... (50% of estimated value of similar work in last three years) OR c) He should have successfully completed three single orders of value ..... (40% of estimated value of similar work in last three years).	Performance Certificates from the utilities / clients

Annexure-2

TATA POWER	The Tata Power Company Limited **Corporate Engineering-Quality Assurance** **Inspection & Testing**	TATA
TPQAIT-QAXX-00-EX-SQP-083 **REV.0**	**STANDARD QUALITY PLAN FOR RELAY PROTECTION and AUTOMATION PANEL**	**Date of Issue:**

STANDARD QUALITY PLAN FOR RELAY PROTECTION and AUTOMATION PANEL

		RP 06/04/2015.	CRB 6/4/2015.	6/4/2015	
0	Initial Submission.	RP	CRB (Head QAI- E)	SGP Chief (QAIT)	
Revision No.	Reason for revision	Prepared By & Date	Checked By & Date	Approved By & Date	Issued by & Date

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TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	TATA
TPQAIT-QAXX-00-EX-SQP-083 REV.0	STANDARD QUALITY PLAN FOR RELAY PROTECTION and AUTOMATION PANEL	Date of Issue:

Sr. No	COMPONENT / OPERATION		CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	REMARKS
1	2		3	4	5
1.0	Raw Material:	(Generally in-line with technical specification, drawing and datasheet)			
1.1	CRCA/ HRCA Sheet steel	1	As per IS 513 & approved specification	Test to be carried out by component supplier, TCs to be reviewed by main supplier.	All items TCs to be reviewed by main supplier and to be submitted to TATAPOWER as per requirement.
1.2	IEDs / Numerical relays, (Auxiliary relays, Tripping relays, Trip circuit supervision relays).	1	Type, Rating, Size, Functional test, Software licenses for IEDs, Engineering & Maintenance tools as per approved specification and relevant standards.	Checks To be carried out by Main Supplier.	
1.3	Transducer, Indicating meters (Analog / Digital), Multi Function energy Meter, Cable, Push button, Switches, Annunciations, Test Switches, Hooter, Electronic bell etc.	1	Checks as per Relevant Standards & Specifications	Accuracy test to be carried out by component supplier, TCs verification and visual checks to be done by Main Supplier.	
1.4	CPU, Monitor, Gateway, Disturbance Recording System, Network Switch, Remote terminal unit, BCU, BCPU, Interface modules, Power supply module, Temperature scanner, DC to DC converter, fibre optic cable/ Patch cords, Printer, Modem , Line Interface Unit, Communication converter	1	Visual checks, Type , Rating, Model no, Hardware specification checks, software specification checks & power ON / boot test for CPU, Functional checks including power consumption check for RTU. Software licenses for RTU, Gateway, BCU, BCPU, Engineering & Maintenance tools and Disturbance Record System	Checks to be carried out by main supplier.	
2.0	INPROCESS INSPECTION: (Generally in line with manufacturer standard)				
2.1	Panel Fabrication	1	Dimensional Conformity, Bend Angle, Profile, Deburring & slag removal.	Test to be carried out by panel manufacturer, Verification by main supplier.	Verification of records by TATA POWER.
		2	Surface preparation checks		
		3	Surface Finish, Paint Shade, Finishing, Coating thickness.		
2.2	Panel Assembly test	1	Wiring checks, panel assembly checks as per drawing.	Test to be carried out by main supplier.	
		2	Visual & Dimension checks.		
		3	BOM checks, component lay out checks as per manufacturing drawing		

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	TATA
TPQAIT-QAXX-00-EX-SQP-083 REV.0	STANDARD QUALITY PLAN FOR RELAY PROTECTION and AUTOMATION PANEL	Date of Issue:

Sr. No	COMPONENT / OPERATION		CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	REMARKS
1	2		3	4	5
3.0	FINAL TESTING: (Testing & Measurement as per IS 8623-1/2/3 by main supplier)				
3.1	Routine Tests	1	Visual, Dimension, Paint shade checks and Mounting of all equipment w.r.to GA, BOM, Rating, Type, Make of components, Model no.	As per drawing	Customer Hold Point. (All fully assembled panels shall be lined up for the final testing)
		2	Metal sheet thickness, Coating thickness measurement	TC verification	
		3	Verification of wiring, terminals, lugging, Ferruling, Continuity Check, Metallic tag plate, Colour coding of wires & TB, Earthing, Fuses.	Testing & Measurement as per scheme requirement, relevant standards & specification. (By Main supplier)	
		4	Logic & Functional checks- Sequential Operation (for set of panel, interpanel wiring shall be completed as per scheme)		
		4.1	Configuration checks of IEDs		
		4.2	Integrated checks for Protection and Automation (SAS) as per approved configuration.		
		4.3	Logic checks for control circuit with all interlocks - Local Control		
		4.4	Logic checks for control circuit with all interlocks - Remote Control		
		4.5	Functional checks for supervision and measurement circuit.		
		4.6	Functional checks for indication and annunciation circuit.		
		4.7	Functional checks BCU, BCPU, RTU, Gateway and DR System.		
		4.8	Functional test for door limit switch, thermostat, heater circuit & auxiliary circuit.		
		4.9	Functional check for time synchronization of gateway, DR System and IEDs.		
		4.10	Event, DR, IO checks, from protection to SCADA terminal.		
		5	Secondary injection tests on relays, meters, transducers		
		6	Insulation resistance test on power & control circuits		
		7	High voltage test on power & control circuit. (2 kV for 1 min between all terminals & earth)		
		8	Integration test for Relays, MFM (Multi Functional Meters), Condition Monitoring IEDs & SAS on open communication protocol		
		9	Check communication with DCS or SCADA system for remote operations.		
		10	TTB checks, wiring gauge check for CT & PT wires, super flexible cable verification.		
		11	Earthing continuity checks with earth Bus bar and earthed apparatus.		

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance Inspection & Testing	TATA
TPQAIT-QAXX-00-EX-SQP-083 REV.0	**STANDARD QUALITY PLAN FOR RELAY PROTECTION and AUTOMATION PANEL**	Date of Issue:

Sr. No	COMPONENT / OPERATION		CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	REMARKS
1	2		3	4	5
3.2	**Performance and Acceptance test**	1	Redundancy requirement with a given communication architecture.	Testing & Measurement as per scheme requirement, relevant standards & specification.	
		2	Scheme acceptance based on IEC 61850 Goose messaging.		
		3	Response time in a worst loading condition.		
		4	Sequence of event logging, Disturbance Recorder collection & time synchronization.		
		5	Remote monitoring of relay parameterization and DR collection.		
		6	Inter operatability test (if applicable)		
3.3	**TYPE Test**	1	IP Degree Verification as per IEC 62271-200 clause no 6.7.1	TC verification as per specific IEC/IS standard. Tests to be conducted as per mutual agreement	Valid TYPE tests certificate not older than 5 year is pre-requisite.
		2	Any other special / type test as per technical specifications		
	Any Separate Type/ Design validation tests shall be carried out in accordance with TATA POWER specification/ PO or as per mutually agreed in MQP.				
4.0	**Document review & issuance of IRN**				
4.1	PACKING & PRE-SHIPMENT.	1	Visual Verification.	Measurement & Visual by Main supplier	
		2	Quantity Verification & Packing in cartons		
		3	One hard copy of the as built drawing along with shipping		
		4	Identification.		
4.2	DISPATCH.		Issue of Release note / MDCC.	Customer Hold Point.	

NOTE

A) ALL MATERIAL SHALL BE AS PER APPROVED DRAWING/ DATA SHEET.
B) STATUTORY REQUIREMENTS WILL BE COMPLIED BY THE CONTRACTOR.
C) TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS WILL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY FOR MATERIAL TRACEBILITY.
D) FINAL INSPECTION OF THE MAJOR ACTIVITIES ARE WITTNESSED BY CLIENT AND IT IS HOLD POINT (AT THE DISCRETION TATA POWER)
E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE.
F)INSPECTION OF THE MAINTAINCE SPARES SHALL BE OFFERED ALONG WITH THE MAIN SUPPLY AS PER THE INSPECTION STAGES OF 1 TO 4.
G)CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW.
H)TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER.
I) AS PER SPECIFICATION PROPER PAINTING & PACKING SHALL BE ENSURED BY VENDOR BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE.

Meant for (Internal Circulation / External – Stakeholders Circulation)

B.2_CHAPTER-2B

SECTION-B

THE TATA POWER COMPANY LIMITED

STANDARD
TECHNICAL SPECIFICATION
FOR

Protection and Control system based on Process bus and IEC61850 for 110 / 220 kV substation equipment

(DOCUMENT NO - ENGG/ ELECT/STD-SPECS/92)

Tata Power

Engineering T & D

Rev. No	Date	Revision History	Prepared By	Checked By	Approved By (HOD)
A	04.04.2020	For Comments	VK/VAS	SVD	AM
B	12.10.2020	Final	VK/VAS	SVD	AM 29.04.2021

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7.	Safety & Operational Requirements
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1. INTRODUCTION

The Technical specification covers the complete integrated design of IEC61850-9-2-LE Edition 2 (or latest IEC version available as on date of bid opening) process bus based protection, IEC61850-8-1 Edition-2 station bus, automation and communication system, detailed engineering, manufacture, supply, inspection & integrated testing at Bidder's work, packing, transportation, delivery to site, performance testing, commissioning and handing over, Providing Technical Support for integrated Protection, Automation and Communication system supplied under this project for 145 / 245 kV substation equipment. All equipment, system and services covered under this specification shall comply with all latest applicable statutory regulations and safety codes in the locality where the Equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Wherever in the specifications IED is mentioned, it represents all electronic devices such as relays, BCUs, Merging Units, SCUs etc.

2. PRE-QUALIFYING REQUIREMENTS AND APPROVED VENDORS LIST

i. Please refer Annexure-1 for bidders pre-qualifying requirement.

3. SYSTEM DESCRIPTION AND SCOPE

The scope of work shall include but not limited to following:

3.1. Design of IEC61850-9-2-LE Edition-2 (or latest edition available as on date of bid opening) process bus, IEC61850-8-1 edition-2 GOOSE station bus based digital substation Protection-Automation-Communication system, manufacture, testing at works, integrated FAT performance testing, supply, transport to site, preparation of drawings, Interconnecting Schedule (ICS), relay setting and configurations, services for testing and commissioning of Protection Panels at site with standard engineering practices, IS & IEC standards.

3.2. Supply of 100% redundant system of Merging units, Protection IEDs and communication network. The complete integration of these systems with scope by Bidder includes all networking accessories such as switches, LIU, patch chords, patch panels, ethernet cables, I/O boxes, communication cables supply, laying & networking of the devices for the procured system.

3.3. The Protection-Automation-Communication system shall be designed such that even when all the bays send multiple GOOSE and SV signals, none of the signal shall get delayed or lost. Bidder shall supply suitable networking accessories and design the system considering all practical scenarios.

3.4. All the IEDs in one substation shall be wired in network with an industrial grade computer having necessary software, which will communicate with all IEDs to display alarms, sequence of event logs, carry out setting changes, configuration logic modifications, down loading & analysis of fault records, monitoring and alarm functions, remote communication with the existing DRCA system. The time synchronization for all the IEDs shall be through SNTP. Immediate communication with time stamping shall be ensured.

3.5. Preparation of various GOOSE based schemes. relay configuration, relay settings and its approval from Tata Power before integrated FAT shall be in bidder's scope. The FAT shall not be commenced unless relay configuration and settings approved by purchaser team.

3.6. Combined Protection, automation and communication FAT for 100% of panels at Bidders factory with Tata Power approved load service relay setting and configuration is in Bidders scope.

3.7. For all Main-1, Main-2 AND / OR Group-1, Group-2 MUs and relays, dedicated and separate cable of fibre optic shall be provided which shall be laid through dedicated and separate GI pipes. All the fibre's shall run through GI pipes in switchyard & in buildings and flexible conduits to be used for inter panel looping. Separate GI pipes shall be used for Main & Backup communication network in switchyard and building entrances.

3.8. The fibre cable shall be laid through dedicated GI pipes. At least 4 number of spare FOP cores per fibre cable shall be kept for future use of purchaser.

3.9. Remote end protection CRP or lose relay supply with conventional CT/VT hard wired inputs but IEDs based on IEC61850-8-1 ed-2 protocol for overhead line / underground cable, testing, commissioning, integration with local and remote end existing protection, automation architecture as mentioned case to case basis in relevant sections shall be in bidders scope. For conventional protection supply, bidder shall refer to Chapter 2.3-A Standard Technical specifications for control and protection of 110 / 220kV substation equipment.

3.10. For remote end retrofitting – Preparing complete CRP drawing with retrofitted relay, ICS, relay setting and configuration, additional aux relays required for completion of scheme, getting drawing approval from Tata Power, removal of old relay, matching panel cutout, wiring of new relay and commissioning etc shall be in bidders scope.

3.11. Demonstration / testing of the system at Bidder's works as per the approved Tata Power SQP (attached Annexure-2 with the specifications) before dispatch of the system at site (FAT).

3.12. The relay setting, configuration tool / software shall be freely available to user during entire duration of relay support. If bidder has licensed version of software, it shall provide at least 10 licenses or licenses equal to as many number of IEDs, whichever is higher for purchasers use.

3.13. Numerical IEC61850-9-2-LE process bus based relay testing kit and normal numerical relay testing kit required for site commissioning shall be in bidder's scope.

3.14. Bidder to depute people for supervision & validation of commissioning check points & site equipment test results during Installation, testing & commissioning of the protection and automation system as per Tata Power approved Standard Field Quality Plan (attached with the specifications). The technical expert shall be involved until the equipment is commissioned & handed over.

3.15. Wherever the system is being commissioned in the existing substations, the complete integration of the new system vis a vis existing system of protection, automation and communication shall be in bidder's scope. Wherever necessary, bidder shall do the site visit and take all the relevant information during pre-bid at its own resources.

3.16. All required man, material, upgradation, replacement, retrofitting etc for seamless integration of new system with existing Protection-Automation-Communication system shall be in bidder's scope.

3.17. Bidder shall adhere to General requirements of Quality Assurance & Inspection (attached with the specifications).

3.18. Submission of type test report which is not more than 5 years old. The Type test report shall be in line with Digital Sub-station i.e. type test report for the IEDs and system offered under this project (Protection, Automation and Communication)

3.19. Bidder must agree for handing over, to Purchaser, all project related drawings in AutoCAD format only. The pdf versions of above drawings shall be submitted through "Wrench" project management software for formal approval process.

3.20. The offered Process Bus based digital substation should comply to Cyber security standards and guidelines. Refer the Automation specification for more details

3.21. The bidder shall thoroughly validate all the engineering schemes, design, IED configuration, SCL/SCD/ICD files at station bus and process bus levels, system architecture etc at 3 intervals. One validation shall be at the start of engineering. Another validation shall be after approval of drawings and configurations before FAT and third validation shall be final one after site commissioning. The validation approval shall be from parent European / US based divisions designated senior employee with experience of at least 15 years and designation of not less than Head or Chief of Engineering / Commissioning / R&D / Design.

3.22. It is not the intent of this specification to specify completely herein, all details of design & construction protection, automation and communication system. However, the bidder shall include and supply the required material and resource at any stage of the project for successful commissioning of the system. The equipment shall conform in all respects to high standards of engineering, design & workmanship.

4. CODES & STANDARDS

4.1. CBIP protection guidelines combined with IEC61850-9-2-LE, IEC61850-8-2 edition-2 standards

4.2. The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve vendor of this responsibility.

4.3. Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC Standards as given below:

Sr No	Standard no.	Title
Digital substation guidelines		
1	IEC61850-9-2-LE Ed-2 IEC61850-8-1 Ed-2	> Completely interoperable digital substation
Characteristic, Performance, Accuracy, Burden, Mechanical endurance test		
1	IEC-60255-6	> Thermal requirements > Mechanical requirements > Limiting dynamic value > Accuracy requirements > Rated Burden
2	IEC-60255-11	Interruption to and alternating component in DC aux. Energizing quantity
3	IEC-60255-3, IEC-60255-12, IEC-60255-13	Relay characteristic & Performance test
4	IEC-60255-23	Contact Performance test
Electromagnetic Compatibility type test:		
1	IEC-60255-22-1, Class-III,	1MHz burst immunity test
2	IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III	Electrostatic discharge test Direct application Indirect application
3	IEC-60255-22-4, Class-A	Fast transient / burst immunity test
4	IEC-, 60255-22-5	Surge immunity test
5	IEC-60255-22-7, Class-A	Power frequency immunity test
6	IEC-61000-4-8, Class-V	Power frequency magnetic field Test
7	IEC- 60255-22-3	Radiated electromagnetic field Immunity
9	IEEE/ANSI/C37.90.2	Radiated electromagnetic field Disturbance

Sr No	Standard no.	Title
10	IEC- 60255-22-3	Immunity to conducted disturbances induced by radio frequency fields test
11	IEC- 60255-25	> Electromagnetic emission tests > Conducted emission test > Radiated emission test
Insulation tests:		
1	IEC- 60255-5	Dielectric test Impulse voltage test Insulation resistance
Environmental tests:		
1	IEC-60068-2-1	Cold test
		Storage test
2	IEC-60068-2-2	Dry heat test
3	IEC-60068-2-3	Damp heat test, steady state
4	IEC-60068-2-30	Damp heat test, cyclic
5	IEC-60068-2-48	Storage temperature test
CE compliance		
1	IEC- 60255-26	Electromagnetic compatibility Requirements
Mechanical tests		
1	IEC- 60255-21-1	Vibration
2	IEC- 60255-21-2	Shock and bump
3	IEC- 60255-21-3	Seismic
Degree of protection test		
1	IEC 60529	Degree of Protection Provided by enclosure test
Safety test		
1	IEC 61010-1	> Single fault condition assessment > Earth bonding impedance test Mechanical resistance to shock and Impact > Rigidity test > Impact hammer test > Protection against electrical shock Protection against the spread of fire

5. DESIGN REQUIREMENTS

5.1. The proposed digital substation is having conventional CT & VTs which shall be connected to IEC61850-9-2-LE Ed.2 or latest based merging units. From merging units and onwards, the complete digital substation shall be designed.

5.2. All the Merging units and IED's supplied shall have conformal coating and shall be based on IEC61850-9-2-LE Ed-2 process bus control and protection.

5.3. Each relay and merging units shall have redundant ports for connection in ring type substation automation architecture.

5.4. Following is the protection and merging unit requirement per bay equipment:

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Merging Unit (MU) with approx. minimum number of Analog & Binary Input / Outputs ($)
TYPE-A1 110 kV / 220 kV Line / Transfer breaker protection	IED-1: IED with Dist (with 1-ph Auto reclose) + Diff + Dir OC/EF + Dir OLTS + LBB + Over voltage + Under Voltage + Sync check	Main-1 & 2 IED's shall be from different OEM. The MU's shall be of same make as that of IED for seamless integration. For 3 terminal lines, the differential modules shall be provided accordingly. Minimum 4 setting groups shall be available in each IED for line protection. For transfer breaker, minimum 06 nos of setting group facility is required.	(1 for Prot PNL) + (1 for PROCESS BUS PNL)	MU1 – With 4 current, 4 Voltage, 12 BI & 12 BO. Line OLTS function shall operate trip relays in UFLS Process Bus Panel.
	IED-2: IED with Dist (with 1-ph Auto reclose) + Diff + Dir OC/EF + Dir OLTS + LBB + Over voltage + Under voltage + Sync check			MU2 – With 4 current, 4 Voltage, 12 BI & 12 BO
TYPE-B1 110 kV / 220 kV Buscoupler / Bus section breaker	One IED with Directional OC/EF + LBB + Sync check	Minimum 4 setting groups shall be available in IED.	(1 for Prot PNL) + (1 for PROCESS BUS PNL)	MU-1 (BC/BS both side CTs and protection core VT) – With 8 current, 8 Voltage, 12 BI & 12 BO MU-2 (BC/BS both side CTs and protection core VT) – With 8 current, 8 Voltage, 12 BI & 12 BO

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Merging Unit (MU) with approx. minimum number of Analog & Binary Input / Outputs ($)
TYPE-C1 220-110/33 kV (HV-MV/LV) Auto Transformer / ICT	**Group-1:** IED-1: IED with Overall Biased Differential + NGT High & Low imp REF + Over fluxing + Thermal O/L + ICT SEF + LV OC + LV LBB + Sync check + HV Dir OC/EF + LBBU	Group-1 & Group-2 IEDs shall be from different manufacturer. The MU's shall be of same make as that of IED for seamless integration. The Group-1 & Group-2 IEDs shall be capable of handling differential protection between at least 5 winding/breakers along with other functions mentioned for respective IEDs.	(2 for prot PNL) + (3 Process bus PNLs one each for HV, MV & LV Group-1 & 2) + (1 outdoor Process bus PNL for Transformer devices) + (1 outdoor Process bus panel for NGT)	Group-1 MU1 (HV) – With 4 current, 4 Voltage, 12 BI & 12 BO Group-1 MU2 (MV) – With 4 current, 4 Voltage, 12 BI & 12 BO. For MV OLTS, 4 nos of RXMH2 or equivalent trip relays along with wiring shall be provided in Process Bus Panel for individual feeder tripping.
	Group-1: IED-2: ICT High & Low impedance REF (Phase wise 3-ph protection) + NGT SEF + MV Teed + MV Dir OC/EF + MV LBB + MV OLTS + LV OLTS			Group-1 MU3 (LV) – With 8 current, 4 Voltage, 12 BI & 12 BO. For LV OLTS, 6 nos of RXMH2 or equivalent trip relays along with wiring shall be provided in Process Bus Panel for individual feeder tripping. Group-1 MU4 (Transformer Devices) – With 24 BI, 8BO for transformer devices Group-1 MU5 (NGT) – With 4 current, 16 BI, 8 BO for transformer devices
	Group-2: IED-1: IED with Overall Biased Differential + NGT High & Low imp REF + Over fluxing + Thermal O/L + ICT SEF + LV OC + LV LBB + Sync check + HV Dir OC/EF + LBBU			Group-2 MU1 (HV) – With 4 current, 4 Voltage, 12 BI & 12 BO Group-2 MU2 (MV) – With 4 current, 4 Voltage, 12 BI & 12 BO

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Merging Unit (MU) with approx. minimum number of Analog & Binary Input / Outputs ($)
	Group-2: IED-2: ICT High & Low impedance REF (Phase wise 3-ph protection) + NGT SEF + MV Teed + MV Dir OC/EF + MV LBB + MV OLTS + LV OLTS			Group-2 MU3 (LV) – With 8 current, 4 Voltage, 12 BI & 12 BO. For LV OLTS, 6 nos of RXMH2 or equivalent trip relays along with wiring shall be provided in Process Bus Panel for individual feeder tripping. Group-2 MU4 (Transformer Devices) – With 24 BI, 8BO for transformer devices Group-2 MU5 (NGT) – With 4 current, 16 BI, 8 BO for transformer devices
TYPE-D1 110/33 kV, 110/22 kV Delta-Star (^Star-Delta) Power transformer	IED-1: Biased Diff + HV Dir OC EF + HT LBB + LV (^HV) Low Imp REF + SEF + LV-1 OC + LV-1 LBB	Main-1 & 2 IED shall be from different manufacturer. These IEDs shall also be capable handling differential protection between at least 3 winding/breakers along with other functions mentioned for respective IEDs.	(1 for Prot PNL) + (1 for HV Process bus MUs) + (1 for LV-1 & 2 Process bus MUs) + (1 for Transformer Devices)	Group-1 MU1 (HV) – With 4 current, 4 Voltage, 12 BI & 12 BO Group-1 MU2 (LV-1 & 2) – With 8 current, 8 Voltage, 12 BI & 12 BO. For LV OLTS, 6 nos of RXMH2 or equivalent trip relays along with wiring shall be provided in Process Bus Panel for individual feeder tripping. Group-1 MU3 (Transformer Devices) – With 24 BI & 8 BO
	IED-2: Biased Diff + HV Dir OC EF + HT LBB + LV (^HV) Low Imp REF + SEF + LV-2 OC + LV-2 LBB			Group-2 MU1 (HV) – With 4 current, 4 Voltage, 12 BI & 12 BO Group-2 MU2 (LV-1 & 2) – With 8 current, 8 Voltage, 12 BI & 12 BO Group-2 MU3 (Transformer Devices) – With 24 BI & 8 BO

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Merging Unit (MU) with approx. minimum number of Analog & Binary Input / Outputs ($)
	IED-3: LV OLTS (^NGT High & Low imp REF + NGT SEF)			----------
TYPE-E1 110 / 220 kV GIS busbar protection	Scheme-1 - IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection	Scheme-1 & 2 shall be 100% redundant and shall be from different manufacturer. Total number of bays covered in this protection is mentioned in respective sections. Bidder shall consider additional 4 number of bays along with mentioned bays for future expansion in both IED-1 & 2 during design of bus differential protection.	2 Protn PNL	Busbar shall fetch baywise currents, status of breaker and isolator from respective bay Main-1 / Group-1 MUs. Separate MU for busbar protection is not envisaged.
	Scheme-2 - IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection			Busbar shall fetch baywise currents, status of breaker and isolator from respective bay Main-2 / Group-2 MUs. Separate MU for busbar protection is not envisaged.
TYPE-F1 110 / 220 kV AIS busbar protection	Scheme-1: IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection	Scheme-1 & 2 shall be 100% redundant and shall be from different manufacturer. Total number of bays covered in this protection is mentioned in respective sections. Bidder shall consider additional 4 number of bays along with mentioned bays for future expansion in both IED-1 & 2 during design of bus differential protection.	2 Prot PNL	Busbar shall fetch baywise currents, status of breaker and isolator from respective bay Main-1 / Group-1 MUs. Separate MU for busbar protection is not envisaged.
	Scheme-2: IEDs with busbar Biased differential protection + CT open circuit alarm / blocking + LBBU + End fault detection			Busbar shall fetch baywise currents, status of breaker and isolator from respective bay Main-2 / Group-2 MUs. Separate MU for busbar protection is not envisaged.
TYPE-G1 Under frequency load shedding	Main-1: IED with 5 stages of Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration	Main-1 & Main-2 IEDs shall be form different manufacturer. Minimum 4 settings group required.	(1 Prot PNL) + (1 for Process Bus)	UFLS relays shall fetch voltages from bus coupler / bus section bay MU's. Also, individual Line bay OLTS shall give trip command in soft to UFLS MU. A separate MU with 12 BI & 12 BO shall

Equipment Name	Protection	Remarks	Number of panel per bay ($)	Merging Unit (MU) with approx. minimum number of Analog & Binary Input / Outputs ($)
	Main-2: IED with 5 stages of Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration			be supplied for tripping purpose. Total 20 nos of RXMH2 or equivalent trip relay along with complete wiring of each contact for tripping of feeders shall be considered in Process Bus Panel.
TYPE-H1 110 / 220 kV Reverse Power Under frequency Islanding scheme	Main-1: IED with 5 stages of Reverse Power protection + Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration Main-2: IED with 5 stages of Reverse Power protection + Under frequency + 5 stages of Over frequency + 5 stages of df/dt + Auto restoration	Main-1 & 2 IEDs shall be from different manufacturer. Minimum 4 settings group required. Each relay shall have capability to take analog inputs from 4 bay CTs for internal CT summation for reverse power calculation based on Section-A.	(1 Prot PNL) + (1 for Process Bus)	RPUF relay shall fetch current and voltage from respective multiple bay MU's for further processing. A dedicated MU with 12 BI & 12 BO shall be supplied for tripping purpose. Total 8 nos of RXMVB4 or equivalent trip relay along with complete wiring for tripping of feeders shall be considered in Process Bus Panel.

Table-1: Details of protection & merging units

($ The number of Panels / AI / BI / BO specified are minimum and approximate. The number of panels is indicative. The bidder shall consider any additional requirement depending upon the scheme requirement)

5.5. Each of the above-mentioned relay shall have at least 10 number of fully user configurable function keys for making IN/OUT of different functions or giving any command to relay for local operation. For remote operation, relay shall receive commands through IEC61850 from SCADA. The relay shall have at least 20 nos of user configurable memory-based Set-Reset Flip Flops for IN/OUT of the relay internal functions.

5.6. In case of GIS substation, it is proposed to keep process bus panels of near LCP / GIS switchgear for all bays.

5.7. For transformer devices and NGT related MU's, it is proposed to keep process bus panels in the outdoor environment near transformer yard and NGT yard respectively based on availability of space. For transformer LV 22/33kV side CT/VT & tripping purpose, it is proposed to keep LV related process bus panels and UFLS process bus panel near 22/33kV switchgear.

5.8. Optical modules of the all line Differential relays shall support C37.94 protocol and should be integrable with SDH mux's, MPLS devices supporting C37.94 interface. The interface should be capable of transferring simultaneously carrier acceleration, Differential Protection, Direct trip and other protection functionalities on single optical port.

5.9. Complete system shall be designed considering following system requirement:

a) No single activity on Main-1 relay / MU / networking accessories / Communication system etc shall affect Main-2 system.

b) In case of failure of any one Main-1 MU, the protection IEDs dependent on that MU shall automatically switch over to take inputs from Main-2 MU and vice versa. Relays shall automatically select sampled values and goose signals from either of the MU depending on quality of signal.

c) No single failure shall result in the loss of control or protection of more than one bay.

d) Physical isolation of Main-1 Protection and Automation system for Testing / troubleshooting shall be possible without affecting Main-2 branch.

e) Physical isolation of single bay for Protection and Automation for Testing / troubleshooting shall be possible without affecting other system.

f) Total fault clearance time shall at least achieve the level of performance of conventional substation (viz. fault clearance within 2-3 cycles).

5.10. In case of AIS substation, it is proposed to keep all MUs in outdoor type environment near bay marshalling box or near equipment as per space availability in the substation.

5.11. Outdoor cubicle / panel shall be compliant to IP65 degree of protection.

5.12. All MCB fail status, IEDs fail status and other monitoring signals are considered for hard wiring to dedicated input of miscellaneous RTU.

5.13. The Merging units and numerical protection relays shall have the following features:

5.8.1. MERGING UNIT REQUIREMENTS

i. Merging Units (MU) shall digitize the conventional CT and VT values as per IEC 61850 Sampled Measured Values (SMV). All MUs shall derive zero sequence voltages and currents internally based on 3-phase inputs connected to it.

ii. MUs shall be able to withstand the electrical and environmental conditions of the switchyard, like, temperature (preferably in the range of -25˚C to 70˚C temperature), humidity, electromagnetic interference (EMI/EMC) conditions, radio interference etc.

iii. The conventional AIS / GIS CT's, VT's, interface to the switchgear primary equipment, circuit breaker etc. shall done through MUs based on project design. The MU shall handle these inputs directly and convert them into standard digital format.

iv. The merging units (MU) shall be conformal coated and suitable for non-air-conditioned outdoor application. It is proposed to place these MU's near LCP / separate panels for GIS applications and Marshalling boxes for AIS applications unless otherwise specified.

v. The merging unit shall be able to publish two kinds (streams) of sampled values profiles: Protection profile (80 sample/cycle) and Measurement profile (256 sample/cycle grouped in 32 frames with 8 points).

vi. The MU shall support both 1A/5A CT secondary connections without changing the hardware. It shall be possible to change the CT secondary rating in parameter settings.

vii. PT Voltage inputs- Rated nominal voltage of 50 V AC to 140 V AC, 50 HZ. The MU VT input shall withstand 240 V AC continuous and 360 V AC for 10 seconds.

viii. Current inputs – Rated nominal currents of 5A and/or 1 A at 50 HZ, shall withstand 2 x Ir continuous current and 100 x Ir for 1 sec.

ix. Modelling of MUs shall adhere to IEC 61850 standard. Logical nodes, such as, TCTR and TVTR shall be used as the interfaces to Current Transformer and Voltage Transformer respectively. Engineering of the device shall comply with IEC 61850 Part 6 (Substation Configuration Language)

x. The merging unit shall support to latest edition of IEC 61850 process bus by sending sampled values of analog currents and voltages. The measured values shall be transferred as sampled values using the IEC 61850-9-2 LE protocol. Merging units with process bus based applications shall use IEEE 1588 (latest version) for high accuracy time synchronization.

xi. The merging unit shall send and receive signals from other devices using the IEC 61850-8-1 edition 2.0 GOOSE (Generic Object Oriented Substation Event) profile.

xii. There shall not be any intermediate transducer, converters etc between relays, MUs and conventional CT/VT's. These inputs shall be directly connected.

xiii. The merging unit shall receive e.g. trip command from protective relays or any other command from the devices in network through GOOSE. The MU shall be capable for executing high speed high burden trip contact operation as defined by the IEC 61850 standard (<10ms data exchange between devices). Also, the MU contacts shall withstand breaker trip coil make and break currents.

xiv. The Merging unit shall have inbuilt breaker pre / post trip circuit supervision (TCS) functionality for 2 trip coils per breaker or 6 trip coil per breaker depending on switchgear trip coil configuration. In case MU is not able to do TCS, a separate hard wired trip coil supervision relay shall be supplied by bidder.

xv. Adequate no of programmable output contacts. Output contacts rated for tripping duty as per IEEE C37.90 standards. Additionally the binary output shall be capable to make and break DC currents (10Amp) of close / trip coils.

xvi. All binary input, output, auxiliary relay contacts shall be wired up to TB irrespective of it is used or kept spare.

xvii. A MU faulty shall be internally detected and an alarm contact shall be wired for annunciation to SCADA system.

xviii. The MU shall be of modular design for quick enhancement / replacement based on site requirement.

5.8.2. Numerical relay requirement

i. Numerical IEDs shall be capable to handle to IEC61850-9-2-LE & 8-1 Ed-2 for process bus data and GOOSE data respectively.

ii. Relay shall have dual redundant optical ports for process and station bus respectively. Total 4 ports; 2 each for process and station bus. Additionally redundant ports shall be available for protection viz. line differential etc.

iii. The IEDs, shall have the capability to internally summate the Sampled Values (SV) streams from two or more instrument transformers

iv. During the GOOSE communication engineering, it shall be ensured that the publishing IEDs shall have the quality attribute included invariably for each GOOSE message in the GOOSE dataset. Further, the subscriber IEDs shall not use any GOOSE message which it receives without the quality attribute.

v. The GOOSE subscribing IEDs shall have the feature of detecting duplicate GOOSE message and intrusion using State Number (StNum), Sequence Number (SqNum) fields of a GOOSE message. Once duplicate GOOSE messages or intrusion is detected, the subscribing device shall discard the GOOSE messages from that publishing device and shall generate an alarm.

vi. If the association between the publisher and subscriber is lost, the ‘validity’ field of the quality will be set to questionable, and the detailQual ‘oldData’ will be set. The rest of quality fields will not be changed.

vii. A guideline over usage of logical nodes for Report Control/ GOOSE control engineering shall be issued during the detailed engineering.

viii. In the control and protection schemes, wherever GOOSE messages are used, the schematic documents submitted by the vendor should indicate the communication between LNs used in the indicating the source and destination LNs.

ix. Firstly, when a subscribing IED stops receiving SMV streams from the Merging Unit(s), alarms shall be generated. Secondly, there shall be a mechanism in the IEDs to detect using the SMV streams, the loss of time synchronization of Merging Units. In case, the IEDs are not receiving the Sampled Values or are receiving improper Sampled Values from the Merging Unit, the IEDs shall not process their functions which utilize those Sampled Values.

x. Numerical IEDs shall have sufficient number of functions, logic gates, flip flops, timers, signal handling capability, function keys, events, DR recording facility etc for seamless implementation of protection philosophy matching with conventional protection system through digital platform.

xi. All IEDs, networking accessories with process bus communication shall support to at least 1 Gbps or higher bandwidth depending on station requirement. Specifically, busbar protection relays shall support 1Gbps.

xii. For line protection, all the line protection related signals viz. Carrier send, carrier receive, DT send, DT receive, Differential Intertrip, Differential Comm fail, Differential OUT, Earth switch ON status etc shall be routed through differential fibre. There shall be at least 6 digital channels available in differential relay for configuring these signals through differential fibre to remote end relay.

xiii. All IEDs shall derive zero sequence voltages and currents internally based on 3-phase CT/VT inputs received from MUs and shall be able to use it for protection purpose.

xiv. In case of loss of quality of sampled values CT / VT input to relay due to any reason, it shall automatically select other set of good quality relevant CT and VT sampled value input.

5.8.3. ACCESS / COMMUNICATION to IEDs

i. Local Operating Interface: USB / Ethernet / RS232 Port / Serial Port on Front Panel preferably USB or optically isolated 9-pin DSUB for the configuration and monitoring of the relay locally.

ii. All protection relays & MUs shall be of numerical type (IED's) with fibre optic communication interface compliant to IEC-61850-9-2-LE process bus and IEC61850-8-1 edition 2.0 station bus protocol with dedicated dual ports. It shall be possible to fully utilize the metering, protection and control features of the numerical IEDs. They shall have programmable logic facility with built-in timers.

iii. The IEC-61850 compliant numerical IEDs shall in turn be networked as per Automation-Communication specs. Events shall be time stamped in the IEDs with a resolution of 1 ms. Time synchronizing pulse in SNTP format shall be transmitted to all devices in the entire network through any two of the managed Ethernet switches, in each LAN network.

iv. Along with CRP panels, a separate Disturbance Record Control Analysis (DRCA) panel shall be considered by bidder which houses industrial PC, network switches, LIU, firewall etc. All the IEDs shall be connected to the DRCA system through a network LIU, patch cords, switches etc. The DRCA system shall have a single software through with IEDs of all OEMs can be communicated for retrieving DR, settings parameterization and relay configuration. The DR retrieval shall be automatic, and frequency of DR retrieval shall be settable. All the DR shall be time sync with GPS clock. Bidder shall be responsible for Integration of new CRP with DRCA system at each station.

v. Establishing communication between all IEDs upto DRCA system, through requisite communication cable and communication accessories is in bidder's scope. This will include supply, installation and testing of communication cable, accessories, local communication network (including fiber splicing) from MU to relay panels to DRCA Panel and final Ethernet connectivity to DRCA system.

vi. Bidder to consider dedicated Relay port for integration with the DRCA system apart from station bus and process bus ports.

5.8.4. EXTENDED LOADING CAPABILITY

i. The IED configuration logics, signals, GOOSE messaging etc. shall be retained in non-volatile memory even after DC on/off cycles.

ii. A sequence of events record consisting of the latest time-tagged events.

iii. Fault records with defined pre-& post trigger waveforms of voltage and current measurements, contact input and output status, and relay element conditions.

iv. All protection IEDs shall support a battery-backed time clock to retain date and time during de-energization.

5.8.5. SOFTWARE FOR INTERFACES for IEDs

User software shall be menu driven and shall be compatible with Windows 10 or higher operating system. Software version for all the IEDs & MUs shall be same. Using the software, the user shall be able to view and set the settings, configure the input & output relays and LED's, comparison between two sets of settings, create programmable logic scheme, view on line metering data, event log, download fault events, load files from PC to the relay and relay to PC, and print all settings. The software should allow selective access to various users based on the password used. The system shall support multi user password privileges. All user privileges shall be controlled by the assigned administrator of the system.

5.8.6. POWER SUPPLY REQUIREMENT

The relay and merging unit shall operate on universal power supply of 85 V AC/DC to 250 V AC/DC and shall withstand 315 V DC or 300 V AC for 1 sec. Rest all the accessories in the panel shall operate at -20% / +10% of rated supply continuously. Station wise AC/DC rated voltages are mentioned in the respective sections.

5.8.7. FEATURES FOR PROPOSED PROTECTION SYSTEM

The protection system shall be built on the latest technology and the bidder must guarantee for supply of spares for at least 15 years. Further the bidder should have full range of manufacture of the system offered.

Wide setting ranges with fine setting steps for each protection shall be available. Details of Protection features

A. Distance Relay Protection 21

The characteristic of Main protective system shall be directional quadrilateral. The maximum operating time of the scheme including carrier/FOP transmitting/receiving time shall not be greater than 25 milli second even during minimum generating condition. The setting range of the relay shall be continuously adjustable and should be suitable for the line data furnished. The relay shall have four forward zones and one reverse zone. The relay shall be able to detect load encroachment. The relay shall have power swing blocking, single and three phase tripping and auto reclose features. The power swing blocking shall include choice of all standard/ Transfer trip modes available and the weak in feed tripping feature.

i. Curves showing variation of operating time for faults in different parts of first zone, especially as the fault position approaches the cut-off point shall be furnished. Operating curves for different source to line impedance ratings shall be furnished. The operating time for Zone 2, Zone 3, Zone 4 and reverse Zone shall be continuously and independently adjustable from 0 to 3 seconds.

ii. The maximum value of source impedance to line first zone setting impedance at which relays measure accurately shall be stated. The characteristic angle of the measuring element shall be continuously adjustable to match the line angle. Necessary adjustable compensation shall be provided for earth fault relay for correct measurement.

iii. The protection shall operate instantaneously (SOTF) when circuit breaker is closed on to any type of faults on the line.

iv. The protection system offered shall be suitable to adopt PURCHASER's /Fibre optic communication system. Provision shall be made for receiving the FOP signal and tripping of the breaker. Breaker failure protection commands shall trip remote end breaker by direct transfer trip through differential FOP channel. All the signals viz. Carrier send, carrier receive, DT send, DT receive, Differential Intertrip, Differential Comm fail, Differential OUT, Earth switch ON status etc shall be routed through differential fibre. There shall be at least

6 digital channels available in differential relay for routing these signals through differential fibre to remote end relay.

v. The Scheme shall have suitable relay to prevent mal-operation of distance protection scheme in the event of VT secondary fuse blowing out.

vi. The distance scheme shall also incorporate necessary relay to energies auto-reclosing relays. Auto-reclosing of single pole on single pole tripping due to phase to ground faults shall be provided. Also, facility should be provided for Tripping and auto reclosing of three phases (after Synchro-check) for single phase to earth faults. A selector switch to make auto-reclosing scheme inoperative shall also be provided. Auto reclosure shall also be blocked when carrier is out of service.

vii. Bidder to consider control cables for communication between relay panel and multiplexer panel along with services for terminating and testing.

B. Numerical FOP based Line Differential Protection 87L

i. The relay shall be used with optical fiber. Wherever specified, the relay supplied shall be suitable for 3 terminal line differential protection.

ii. Line Differential protection shall be a comparison type unit protection to detect phase and earth faults. As with all unit protection, Line differential scheme shall have an exactly defined zone of operation and tripping shall be without any intentional delay. Supervision facility for FOP shall be provided. The scheme shall not operate for the external faults.

iii. The interfacing equipment for FOP signalling system required by above scheme shall form a part of protection system itself. As these protections are offering unit protection, it is also required that the protection system offered shall include equipment for both ends of the line. The price quoted shall be for the complete system. The detailed cost break up for the system shall be furnished in the Bid.

iv. The scheme offered shall also be suitable for single phase tripping and reclose on phase to ground faults as in the case of distance protection. The BIDDER shall furnish technical

particular of the system offered. Maximum operating time of protection shall be 25 milli second inclusive of carrier receipt and transmission.

v. In the absence of FOP, the line differential protection shall be capable of providing Dir. O/C protection the pickup of which can be adjustable.

vi. Line differential protection shall be made inoperative when the line is transferred on Transfer breaker.

vii. Line differential protection will be either on direct fibre Single mode or Multimode through Multiplexer as per the details given in Communication specification. The offered relay optical modules to support driving optical signal to the distance as given in the specification.

viii. Bidder to consider communication networking accessories such as fibre cables, termination boxes (LIUs), patch cords, conduits and termination services.

ix. All the signals viz. Carrier send, carrier receive, DT send, DT receive, Differential Intertrip, Differential Comm fail, Differential OUT, Earth switch ON status etc shall be routed through differential fibre. There shall be at least 6 digital channels available in differential relay for routing these signals through differential fibre to remote end relay.

C. *Power Transformer / ICT / Auto transformer Differential Protection 87T*

i. 87T shall be discrete relay having three winding biased differential for power transformer and 4 winding facility for ICT / Auto transformers.

ii. 87T shall be a biased differential protection and shall be provided with 2nd & 5th harmonic restraint feature.

iii. Transformer vector group and transformation ratio correction with different CT rated current (1A/5A) shall be settable inside the relays.

iv. The relay shall have facility to detect CT saturation and open CT with settable blocking facility.

D. Over fluxing Protection (24)

i. Over fluxing Protection: Over flux protection shall be provided based on Volts/Hertz measurement.

ii. For transformers, the overfluxing relay shall take input from LV side bus to which it is connected.

iii. Two definite – time and one selectable inverse time curve shall be provided. The inverse time element shall have a settable reset timer to account for thermal effects of repeated violation of the settings.

iv. The overexciting protection shall operate properly over a range of 20Hz to 60Hz.

E. High Impedance Differential Protection 64 REF for star winding

i. The high impedance 64 REF shall be provided with a suitable stabilizing resistor and protective metrosil arrangement. The stabilizing resistor shall be settable over a suitable range like rheostat and shall have sufficient wattage rating.

ii. This protection shall be provided phase wise in case of ICT and auto transformers.

F. Numerical Directional Overcurrent & Earth Fault Protection (67 and 67N)

i. In addition to Main protection, feeders/lines shall be protected by back up protection numerical directional Numerical (IDMT) over-current relay and earth fault relays.

ii. It should derive zero sequence voltage and current internally for earth fault protection.

iii. It shall have a setting range of 5 to 200%. Relay shall have Directional O/C and earth fault feature. The relay characteristic angles shall be settable between 0 to 360 degrees for both phase and earth fault.

iv. The relay shall have all IEC/ANSI Characteristics with settable forward and reverse direction for all stages.

v. The relay shall also include a high set instantaneous over-current unit with a continuously adjustable setting range of 500-2000% of rated current. The relays shall have fault disturbance recording and remote communicating facility.

G. LBBU Protection (50Z)

LBBU protection shall be part of main protection. In such a case it should be possible to initiate the built-in LBB protection by external trip relay contacts.

i. LBBU shall be initiated by bay lockout relay and shall give trip signal to its own breaker and the breakers connected to the same bus, after predetermined time delay through busbar tripping relays.

ii. The LBB protection gives tripping command to bus bar tripping relay only after ensuring that Main or any other protection has already operated.

iii. The relay shall be three phase having an operating time less than 20 milli seconds. The setting range shall be 5 to 100% of rated current. A time delay with a continuously adjustable setting of 0.1 to 1 sec shall be provided

iv. The relay shall have a continuous thermal withstand capacity to carry two times rated current irrespective of the setting.

v. The Protection shall be suitably designed for 1-ph as well as 3-ph auto-reclosing.

vi. LBBU protection shall be provided with remotely operated IN/OUT command through IEC61850.

H. Numerical Non-Directional Over-current & Earth Fault Protection (50/51, 50/51N)

i. Three phase Numerical (IDMT) over-current relay and numerical (IDMT) earth fault relays shall be provided for phase over-current and earth fault protection.

ii. It shall have a setting range of 50 to 200%.

iii. The relay shall have all standard IEC/ANSI characteristics.

iv. The relay shall also include a high set instantaneous over-current unit with a continuously adjustable setting range of 500-2000% of rated current.

I. Numerical Bus Fault Protection

The bus bar arrangement will be as indicated in the respective single line diagram. The required bus bar differential scheme shall comprise of Numerical Bus Bar System for Z#1 and 2. The IED shall be configured accordingly. Also, the IED shall be suitable for incorporating all bays shown in respective SLD. Accordingly, trip relays with sufficient contacts to be provided bay wise.

The Bus bar protection IN/OUT shall have remote (IEC61850 command based) and local (Function key based) operating facility. Bus bar reset push button shall be illuminated type. End fault protection feature shall be provided.

The bus bar protection shall incorporate feature listed below.

i. Numerical Bus Fault Differential Relay (87B) Operating Principles:

High speed, low impedance, biased differential relay with percentage bias characteristics and an adjustable setting range of 20% to 100% of the rated current per zone shall be provided. Operating elements on all three phases for both the schemes shall be provided and they shall operate for phase to phase and phase to earth faults. The operating time of the relay at 2 times of the pick-up setting shall not be greater than 15 milli seconds. The relay shall remain stable for external fault conditions and shall not operate on transients. CT saturation due to internal faults and external faults shall not affect the performance of the scheme. The relay shall accept CTs with different ratios. Minimum 16 binary I/P and 16 binary output relays with separate +ve and –ve terminals are required. This relay shall not operate due to normal load flow in the bus bars.

ii. Bus Fault CT Secondary Wiring Supervision feature shall be provided in 87B:

Bus bar protection shall get blocked in case of open / short-circuit on the CT secondary circuit. The alarm for the same shall be provided.

iii. Supervision of Auxiliary DC Supplies:

Supervision scheme shall be provided to supervise of all auxiliary DC supplies and the Scheme shall initiate annunciation on DC supply failure.

J. Overload Trimming

An overload (directional) trimming feature shall be provided for each line and transformer bay. 02 nos. self-reset type trip relays for each bay with flag indication shall be provided for load shedding. The relay shall be capable of 3 out of 3 logic. Local (through function key) and remote (through IEC61850 command) operated IN/OUT shall be configured for OLTS scheme.

K. Under frequency relay

The relay shall have:

i. Minimum no of Setting Group: 04 no

ii. Minimum no of under frequency stages: 05 no.

iii. Minimum no of over frequency stages: 04 no.

iv. Minimum No of df/dt stages: 05 no.

Requirement of Load Shedding Scheme:

a. There should be two different settings during normal operation and islanded operation.

b. The settings shall change either automatically or from single SCADA command

c. Each stages should have dedicated IN / OUT facility with remote selection.

Auto Restoration Scheme:

The Requirement of Auto Restoration Scheme is as below:

a. Auto-restoration scheme is to be employed to arrest high frequency variations post islanding.

b. First auto-restoration scheme should restore the load then the settings of islanded mode shall change over to normal mode

c. The auto-restoration scheme will be active only for 60 Sec after islanding and it should restore the designated feeder only if that feeder is tripped on islanding.

d. The load restoration should restore the load on over frequency and rising df/dt together. The restoration should be on three different frequencies.

L. Reverse Power Under frequency relay

Both reverse power and under frequency shall operate simultaneously in one IED.

The relay shall have settings in terms of active / reactive power in primary kW / MW OR in secondary mW / Watts OR in % terms. Power angle shall be settable in degrees from 0 to 360 degrees with step of 1 degrees. The pickup setting step possible shall be 0.1% of rated power or lesser. The stage shall be selectively kept ON / OFF with binary input. Reverse power operate time delay shall be settable between 0.1 to 6000 sec with step of 0.1 sec.

Under frequency with fixed validation time window shall be settable with 45 Hz to 55 Hz window. The pickup step shall be 0.01 Hz. Under frequency operate time delay shall be settable between 0.1 to 6000 sec with step of 0.1 sec.

Total number of reverse power stages required = 04

Total number of under frequency stages required = 04

M. General Requirements of Numerical Relay

Numerical relays shall have a data port for local access using a laptop / PC with Windows 10 or higher version software. The numerical relays of same OEM shall have common software version platform. Each relay shall have redundant dedicated inbuilt Fibre Optic (FO) port each for process bus and station bus.

Details of Numerical relay communication ports are as follows:

CommunicationFront: Ethernet port

Rear: Redundant Dedicated Fibre Optic Port (FO) on IEC61850-9-2-LE process bus connection to Merging Unit. AND

Redundant Dedicated Fibre Optic Port (FO) on IEC 61850 station bus (for integration of IEDs for SCADA and integration with DRCA System local as well as central)

Dedicated GPS receiver will be redundant and common for Process Bus and station Bus for Time synchronization.

N. General Relays

i. Lockout / Tripping Relays (86)

High speed tripping relays shall be provided for trip functions of various protection schemes. The operating time of the relay shall not be more than 10 ms. The pick-up value of the relay shall be in the range of 50 to 60% of rated voltage. Healthiness of the each tripping relays shall be supervised by suitable tripping relay supervision relay. It shall be static type. The lockout reset type relays shall be provided with a local and remote reset facility. There should be an illuminated RESET pushbutton for local indication. The illumination lamp shall continuously withstand -20 to +10% rated DC voltage.

ii. Lockout supervision and Trip Circuit Supervision Relays (95)

Each bistable trip/lockout relay operate coil shall be supervised by a separate TSR relay. The TSR relay shall have 4NO contacts for annunciation. For trip circuit or breaker trip coil, pre-closing and post-closing breaker trip coil supervision shall be provided for all circuit breakers. One relay shall be provided for each trip coil and they shall be connected at the end of tripping loop. Action of the relay shall be annunciated. The relays shall have an inherent limit in time delay of 100 to 200 milli seconds to prevent operation due to transients. The relay shall operate satisfactorily for 80 to 110% of rated supply voltage. It shall be static type.

iii. DC Supply Supervision (80)

DC supply of each protection and alarm scheme shall be monitored by no volt relays. The relay on operation shall give annunciation.

Two DC feeders shall cater to DC power requirements for relay panel. Under normal circumstances, one set of trip circuits shall be supplied by one feeder and another set of trip circuit shall be supplied by the second feeder. For this purpose, two sets of DC busbars shall run for entire length of panels. Provision shall be made to feed the entire length of panel from one supply during outage of other supply by manual changeover. The BIDDER shall include the required equipment for the same.

iv. Carrier / Trip transfer relays:

Latched type bi-stable relays for Carrier, trip transfer, transfer breaker etc shall be provided. These shall have local as well as remote set / reset facility from SCADA. These relays shall have sufficient NO and NC contacts.

v. Automatic Self-Monitoring Facility:

The relay shall have continuous automatic self-monitoring and alarming facilities. The above feature shall not affect the relay availability i.e. when an actual fault occurs in the system during the checking cycle, the above cycle shall be immediately interrupted, and the relay shall check and respond to the system fault. The system shall have the following visual indications for supervision of each command channel.

a. Input activated at transmit end

b. Command transmitted

c. Command received

d. Equipment in local loop test

e. Equipment in remote loop test

f. Test pass

g. Test fail

h. General alarm

i. Equipment in synchronism

O. *In-built Fault Distribution Recorder:*

Disturbance record shall have 3 sec record time, 0.5 sec pre-fault and 10 memory record with internal/external triggering facility.

5.8.8. General Requirements for Panels being supplied under the project

Sheet Metal Work

a. The indoor panel frame shall be fabricated using suitable mild steel structural sections of pressed and shaped cold rolled sheet steel.

b. The outdoor panels / cubicles shall be of non-corrosive stainless steel SS304 material. These panels may be placed in transformer yard or near to outdoor primary equipment.

c. Thickness of material shall be 3 mm for load bearing members (front, base frame and gland plate) and 2 mm for non-load bearing members (Back, side, rear, top cover and bottom). Stiffeners shall be provided wherever necessary. The Panels shall be provided with MS Base frame Channel of 75 x 50 mm with anti-vibration pad.

d. All panel edges and door edges shall be reinforced against distortion by rolling, bidding or by the addition of welded reinforcement member.

e. Cut-Outs shall be without sharp edges.

f. The complete structure shall be rigid, self- supporting, free from vibration, twists and bends.

g. Outdoor panels shall be compliant to IP65 degree of protection.

Constructional Features

a. The Indoor panel shall be of the metal enclosed, floor mounted, Simplex type (W = 800 mm, D = 800 mm, H = 2300 mm) with single door for front with a separate glass door and double door (centre divided) rear opening. All the devices shall be mounted on internal swing door at the front.

b. The outdoor panel shall be SS304 metal enclosed, floor / wall / beam mounted. The panel dimensions and construction shall be decided based on availability of space at site during detail engineering.

b. Made up of the requisite vertical sections suitable to provide a degree of protection of not less than IP 54 as per IS: 2147 when control cabinets are specified for indoor use. For outdoor panel application the IP 65 class shall be maintained,

c. Indoor panel shall be of self-cooled design with adequate louvers on both back doors. The louvers shall have screens and filters on inner side of panel. The screens shall be of fine wire mesh made of brass or GI wire.

d. Provided with labels on the front and rear indicating the panel designation.

e. Provided with cable entry facilities and removable gland plates at required locations.

f. Provided with neoprene gaskets all-round the perimeter of covers, gland plates, removable covers and doors.

g. Safety earthing with Tinned copper earth bus of 150 sq.mm (25mmX6mm). Two Nos. earthing terminals shall be provided at each end of panel to connect PURCHASER's earthing conductor.

h. Simplex type panel shall incorporate operating devices only in the front

i. Strip type space heaters of adequate capacity shall be provided for each panel. Heaters shall be complete with rotary type Auto ON-OFF thermal switch, a single pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heaters at 45 deg C. The space heaters shall be covered with protective mesh. The panels shall have 240V, single phase, 50 Hz, 8 Watt LED light fixtures for interior illumination controlled by ON/OFF switches and 240V, 1 phase, 3 pin receptacles. Power source for

interior lighting and receptacle shall be completely independent of control power source. LED type lamp shall be used for cubicle illumination.

j. Panel shall be designed in such a way that all component/ equipment's operate satisfactorily without exceeding their respective maximum permissible temperature rises under temperature conditions prevailing within the cubicles. Reference ambient temperature outside the switchgear cubicles is specified in the specifications.

k. Cable entries shall be from bottom. Suitable removable cable gland plate shall be provided on the cabinet for this purpose. Necessary number of cable glands shall be supplied/fitted on to this gland plate. Cable glands shall be screw-on type and made of brass.

l. Bottom and Gland plate details:

Bottom plate with two opening size 275 mm X 550 mm

Two gland plates of size 315 mm X 590 mm

m. All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside.

The paint shade for,

Exterior: shall be RAL7032, texture finish.

Interior: shall be White glossy finish

Base frame: Black semi glossy

Thickness: 80 Micron for powder coated

n. Each panel shall be provided with necessary arrangement for receiving, distributing, isolating and protection of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with MCBs. Supply monitoring arrangement shall be provided. Potential circuits for relaying and metering shall be protected by MCBs. MCBs shall have aux. contacts for monitoring.

Cabinet Internal Wiring

a. Control cabinets shall be supplied completely wired, ready for PURCHASER's external connections at the terminal blocks. Wiring shall be carried out with multi-stranded FRLS, 1100V grade PVC having oxygen index 29 and temp. index of 250 Deg. Wiring inside the panel shall be kept in plastic trays.

Following sizes of wires shall be used:

CT wiring	2.5 sq.mm	R / Y/ B / Black
PT Wiring	1.5 sq.mm	R / Y/ B / Black
DC wiring	1.5 sq.mm	Grey
1 ph. Ac wiring	1.5 sq.mm	R / Black
Ground	2.5 sq.mm	Green
Annunciation	1.5 sq.mm	Grey

b. All panel internal wires shall be connected at top of the TB. The bottom of the TB shall be left for field wiring. Enough depth and width of vertical and horizontal cable trays shall be provided considering bunch of external cable entry into panel. Cable tray lid shall properly close after routing field cables into panel. All wires terminated on relays and TBs shall be with sleeved ring type or 'O' type crimped lugs only.

c. Ferrules should be provided for wires. Ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is removed. Spare auxiliary contacts of the relays etc. shall be wired to terminal blocks. All wiring shall be terminated on terminal blocks using crimping type of tinned copper lugs. Insulated sleeves shall be neatly punched and cleaned without affecting access to equipment mounted within the cabinet. Wiring troughs shall be provided for vertical cabinet wiring and for interconnecting wiring between front and rear section of the cabinet.

d. 1.1 kV grade terminal blocks complete with insulated barriers, terminal studs, end plates, washers, nuts and locknuts and identification strips shall be used. All the terminal blocks shall be mounted horizontally (vertical mounting is not acceptable) on anodized channels at an angle to provide easy access at a height of minimum 300mm from the base. All the TBs shall be of disconnecting type, 1100 V Connectwell make, 40 Amp, CBDT4U type. Disconnecting TB rails shall be mounted horizontally in such a manner that when TB link is dropped, it falls due to gravity. At least 20% spare terminal blocks shall be provided in each group (X1, X2 etc). Terminal blocks for control indication etc. shall be suitable for connecting at least two conductors of PURCHASER's cable of following sizes:

i. Potential and control : 2.5 mm2 multistrand copper wire.

ii. CT circuits : 6 mm2 multistrand copper wire

e. Terminal blocks shall be numbered for identification and grouped according to function. Engraved white on black labels shall be provided on the terminal blocks, describing the function of the circuit. There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 100 mm. Terminal blocks shall be provided with transparent acrylic covers.

f. PURCHASER's external cable connections to the control cabinet will be carried out using 1.1 kV grade, stranded copper conductors, PVC insulated, PVC sheathed, armored and PVC jacketed cables. All necessary cable terminating accessories such as packing glands, crimp type tinned copper lugs, supporting clamps and brackets, etc. for PURCHASER's cables shall be included in Vendor's scope of supply.

g. For equipment supplied / to be supplied by the PURCHASER, the bidders shall provide suitable cutouts and wiring shall be done up to the terminal blocks as per purchasers requirement.

Labels

All door mounted equipment as well as equipment mounted inside the control cabinets shall be provided with individual labels with equipment designation engraved. Also the control

cabinet shall be provided on the front with a label engraved with designation of the control cabinet as furnished by PURCHASER. Labels shall be made of non-rusting metal. Labels shall have white letters on black or dark blue background. Sizes of labels and lettering are subject to PURCHASER's approval.

Earthing Terminals

a. Each control cabinet shall be provided with two separate earthing terminals suitable to receive PURCHASER's earthing conductors of size specified.

b. Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wire/bars bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

c. All instrument and relay case shall be connected to the earth busbar using 1100 grade PVC insulated 2.5 sq.mm stranded tinned copper earthing conductor.

d. All hinged doors shall be positively connected to the earthing bus terminals, with the help of braided copper conductors of adequate size.

e. All the earth connections to earth busbar shall be nut bolt type with washer. Screw type connection is not acceptable.

6. LAYOUT REQUIREMENTS OF EQUIPMENT

5.1 The relay panels shall be designed for keeping it adjacent to each other. All the inter panel wiring, FO cables etc shall be facilitated from inside the panel with a proper rectangular cutout at the top side location. The cutout edges shall be properly insulated so that the edges do not damage the cables. The cables shall be bunched together with a PVC spiral guard.

5.2 The copper tinned earth strip of 25 x 6 mm size in each panel shall be located at the bottom of the panel. It shall have arrangement to connect with adjacent panels with the same

dimension material strip on both sides. A suitable cutout shall be made at both sides of panel to make the earth busbar continuous.

5.3 Station specific layout arrangement is mentioned in the respective sections.

7. SAFETY AND OPERATIONAL REQUIREMENTS

7.1 Safety Requirements

All equipment, system and services covered under this specification shall comply with all latest applicable statutory regulations and safety codes in the locality where the Equipment is proposed to be installed. All equipments supplied shall conform to following electrical safety tests as per IEC 61010-1

> Single fault condition assessment

> Earth bonding impedance test Mechanical resistance to shock and Impact

> Rigidity test

> Impact hammer test

> Protection against electrical shock Protection against the spread of fire

7.2 Performance Requirements

The performance test of complete Protection Panel installation under this specification shall be carried out at site as required to demonstrate the guarantees.

Purchaser will participate in all performance tests. The Bidder shall notify the performance test schedule two weeks in advance before carrying out the tests.

7.3 The performance test requirements are as follows:

Commissioning Tests

Trial operations and simulations

7.4 The bidder shall supply a GOOSE Inspection and Simulation Tool. The tool(s) shall have the capability to sniff and inspect the GOOSE in the data network. The tool(s)

shall also have the capability to extract the GOOSE information from .cid/.scd file(s) and simulate them. Bidder shall include this cost in services part.

7.5 For IEC 61850 based Process Bus Projects, the bidder also shall supply a SV (IEC 61850 Sampled Values) Inspection and Simulation Tool. The tool(s) shall have the capability to sniff and inspect the SV in the data network. The tool(s) shall also have the capability to extract the SV information from .cid/.scd file(s) and simulate them. Bidder shall include this cost in services part.

7.6 Any other special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Bidder.

7.7 The Bidder shall prepare all test reports, in which the methods followed, instrument readings, graphs, observations, results obtained etc. shall be recorded. Duly signed detailed report shall be submitted to Purchaser's approval within one week time.

7.8 In case of performance test results deviate from the guaranteed values including the specified tolerance, the Bidder shall correct his equipment at no extra cost and repeat the performance tests. Purchase may retain the option of rejecting the equipment, and in the case of such option of rejection being exercised, the Bidder shall replace the entire equipment with new one which will meet the guaranteed parameters.

7.9 PERFORMANCE & GUARANTEE TESTS

7.10 Combined Protection, Automation and Communication Factory Acceptance Test (FAT) shall be carried by Vendor at factory in presence of Inspection Engineer.

7.11 During FAT all the panels, IEDs, Merging units, schemes etc shall be 100% tested, simulated and checked. It will be 100% FAT for all the panels. Bidder shall provide sufficient resources during FAT.

7.12 Routine tests shall be carried out on all associated equipment as per relevant Indian Standards. Protection Panels shall be subjected to following tests:

a. Routine Tests:

b. High Voltage test (2000 Volts for 1 minute)

c. Detailed Testing of all IEDs, detailed scheme checks during factory inspection with approved configuration and load service settings.

d. Verification of wiring as per approved schematic drawings.

e. Type Tests:

7.13 Certified copies of all type test reports as per Indian Standards shall be submitted for approval before technical discussion.

a. Type Test report for IEDs

b. Temperature rise test on power circuits

c. Short time current tests on power circuits.

d. Mechanical Operation (Vibration) test.

e. Verification of the degree of protection as per IS: 2147.

8 GUARANTEED TECHNICAL PARAMETERS OF EQUIPMENT INCLUDING DATA SHEET

Sl. No.	Description	Tata Power requirement	Bidder compliance
(I)	**Relay Panels – General**		
1.	Type of Panel (Simplex) with front and rear opening	Yes	
2.	Applicable Standard IS /IEC	IS:2147	
3.	Indoor panel - Sheet Steel (Hot Rolled / Cold Rolled)	Cold Rolled	
4.	Outdoor panel non-corrosive Stainless-steel sheet	SS304	
5.	Thickness of Sheet Steel		
a.	Base (in mm)	MS frame 3mm width and 75 x 50 mm size	
b.	Sides & Tops (in mm)	2mm	
c.	Front and Rear (in mm)	3mm	
d.	Base Channel Provided (Yes / No)	Yes	
e.	Anti-vibration pad provided	Yes	
6.	Degree of Protection Provided (Indoor Panel)	IP54	
7.	Degree of Protection Provided (Outdoor Panel)	IP65	

Sl. No.	Description	Tata Power requirement	Bidder compliance
8.	Cable Entry (Bottom /Top)	Bottom	
9.	Thickness of Gland Plates (in mm)	3mm	
10.	Accessories Provided (Yes / No)		
a.	MCB for controlling 240 V AC of Panel	Yes	
b.	Cubicle Space Heater with Thermostat	Yes	
c.	Plug Point with ON-OFF switch	Yes	
d.	LED Lighting Fixture with cover and ON-OFF Lighting switch	Yes	
e.	Nameplates front and rear	Yes	
f.	Acrylic labels for each equipment	Yes	
g.	Indoor panel Overall Dimensions of each Panel (L x D x W)	800 x 800 x 2300	
11.	Earthing Bus Material & Size	Tinned Copper 150 sqmm (25x6 mm)	
12.	Painting		
a.	Method of Painting	Metal Degreased Pickled Phosphated with two coats of each zinc chromate primer and synthetic enamel paint	
b.	Exterior Shade of Paint	RAL7032 Texture finish	
c.	Interior shade of Paint	White Glossy finish	
d.	Base frame shade of Paint	Black semi glossy	
e.	Thickness of paint	80-micron powder coated	
13.	Design Ambient Temperature	50 deg C	
14.	Terminal Blocks		

Sl. No.	Description	Tata Power requirement	Bidder compliance
a.	Make & Model	Connectwell CBDT4U	
b.	Disconnecting type which falls with gravity	Yes	
c.	Voltage and Current rating	1.1 kV, 40 A	
d.	Moulded inter-terminal barriers provided (Yes / No)	Yes	
e.	20% spare terminal provided in each panel each group (Group is X1, X2 etc)	Yes	
15.	Proper cutout provided at top of the panel with proper protection at all edges	Yes	
a.	Multi-strand copper wires provided (Yes / No)	Yes	
16.	Control Voltage (in Volts)	As per station details in relevant sections	
17.	Merging unit can take conventional CT/VT input and convert into IEC61850 process bus digital signals	Yes	
18.	Each of the numerical relay has at least 10 nos of user configurable function keys	Yes	
19.	Trip relays and Auxiliary relay shall be ABB or GE make only (YES/NO)	Yes	
20.	All the Merging units and IED's supplied has conformal coating as per international standards	Yes	
21.	All make of Merging Units is considered same as that of make of respective IED's	Yes	
22.	In case of loss of quality of sampled values CT / VT input to relay due to any reason, it can automatically select other set of good quality relevant CT and VT sampled value input		
23.	All relays can choose bus VT based on bay isolator status.	Yes	
24.	All MCB fail status, IEDs fail status and other monitoring signals are considered for hard wiring to dedicated input of miscellaneous RTU.	Yes	
	Relay Panels – Specific		
A.	**110 / 220 kV LINE or TRANSFER BREAKER CRP panels**		

Sl. No.	Description	Tata Power requirement	Bidder compliance
a.	No. of Relay Panels per bay	2 nos	
b.	For 3-terminal lines, both Main-1 & 2 IED are capable of 3 terminal line differential protection (Yes/No)	Yes	
c.	Numerical IED-1 with TYPE-A Table-1 function's (Mention Relay Model / Order code / MLFB No and quantity). Also furnish respective MU details.	Bidder to mention	
d.	Numerical IED-2 TYPE-A Table-1 function's (Mention Relay Model / Order code / MLFB No and quantity). Also furnish respective MU details.	Bidder to mention	
e.	IED shall send and receive at least 6 nos of signals of local end to remote end and vice versa through differential FOP. In case of 3 terminal line, each end can send and receive 6 signals from other two ends.	Yes	
f.	Wherever specified, the bidder is ready to match IED-1 & 2 with lines remote end IEDs	Yes	
g.	DC selector (Source-1/2/Independent) switch provided (Yes / No) (Per panel 1 set)	Yes	
h.	Transfer breaker bay relays are considered with 06 nos of setting groups	Yes	
B.	**110/220 kV Bus Coupler / Bus section CRP panels**		
a.	No. of Relay Panels for Bus Coupler bay	1 No	
b.	1 no. IED & MU provided as per Table-1 specs (Yes/No)	Yes	
c.	IED with TYPE-B Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
d.	DC selector (Source-1/2/Independent) switch provided (Yes / No) (Per bay 1 set)	Yes	
C.	**220-110/33 kV Auto Transformer / ICT CRP panel**		
a.	No. of Relay Panels for per AT/ICT (2 nos.)	Yes	
b.	All MU's & IED-1, 2, 3 & 4 are provided as per Table-1 specs	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
c.	IED 1 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
d.	IED 2 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
e.	IED 3 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
f.	IED 4 as per TYPE-C Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
g.	Outdoor process bus panel for transformer devices & NGTs are considered as per specs	Yes	
D.	**110/33, 110/22 kV Power Transformer (with one or two LV windings) CRP panel**		
a.	No. of Relay Panels for per Transformer	2 nos	
b.	MU and IEDs are provided as per Table-1 TYPE-D specs.	Yes	
c.	IED 1 as per TYPE-D Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
d.	IED 2 as per TYPE-D Table-1 functions (Note: Even if the specific transformer has only one LV breaker, bidder shall provide LV-2 related protection for future expansion). Also furnish respective MU details.	Bidder to mention	
e.	IED 3 as per TYPE-D Table-1 functions (Mention Relay Model / Order code / MLFB No). Also furnish respective MU details.	Bidder to mention	
f.	Outdoor process bus panel for transformer device is considered as per specs	Yes	
E.	**110 / 220 kV GIS Bus Bar Protection**		
a.	Low Impedance biased differential Type (Yes /No)	Yes	

Sl. No.	Description	Tata Power requirement	Bidder compliance
b.	MU's, Scheme-1 & 2 provided as per Table-1 TYPE-E specs (Yes/No)	Yes	
c.	Busbar relay with number of bays shown in respective SLD + additional 4 spare bays considered for each bus differential application (Yes / No)	Yes	
d.	IED Details (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
e.	Centralized or Distributed	Bidder to mention	
f.	Busbar relay supports to at least 1Gbps bandwidth	Yes	
F.	**110 / 220 kV AIS Bus Bar Protection**		
a.	Both Scheme-1 & 2 are based on low Impedance biased differential protection (Yes /No)	Yes	
b.	Each Busbar relay with number of bays shown in respective SLD + additional 4 spare bays considered for application (Yes / No)	Yes	
c.	Scheme-1 IEDs as per TYPE-F Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
d.	Scheme-2 IEDs as per TYPE-F Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
e.	Scheme-1 IEDs Centralized or Distributed	Bidder to mention	
f.	Scheme-2 IEDs Centralized or Distributed	Bidder to mention	
g.	Busbar relay supports to at least 1Gbps bandwidth	Yes	
G.	**Under Frequency Load Shedding Scheme CRP panel**		
a.	Both IEDs provided as per TYPE-G Table-1 spec (Yes/No)	Yes	
b.	IED-1 with TYPE-G Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	

Sl. No.	Description	Tata Power requirement	Bidder compliance
c.	IED-2 with TYPE-G Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
d.	No. of Trip relays offered (20 nos high burden, self-reset, flag type RXMH2 or Equivalent 6NO each) Shall be self-reset type	Yes	
e.	Auto restoration scheme as given in the specs considered (Yes/No)	Yes	
H.	**110/220 kV Reverse power under frequency CRP panel**		
a.	No. of Relay Panels	2 no	
b.	MU's, IED-1 & 2 offered as per TYPE-H Table-1 specs	Yes	
c.	IED-1 with TYPE-H Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
d.	IED-2 with TYPE-H Table-1 functions (Mention Relay Model / MLFB No / order code). Also furnish respective MU details.	Bidder to mention	
(III)	**Other**		
1.	Warranty for 5 years shall include all the materials under supply and cover performance of digital substation integrated Protection, Automation and Communication system for a period of not less than 5 Years (Yes/No)	Yes	
2.	Any additional number of MU's, IEDs, Aux relays etc for proper completion of scheme is considered by bidder during bid stage itself	Yes	
3.	Offer given as per specification and datasheet for CRP panel System and no deviation taken (Yes/No).	Bidder to mention	

Sl. No.	Description	Tata Power requirement	Bidder compliance
4.	Protection – Automation – Communication integrated FAT for 100% of panels shall be carried out with approved relay configuration and load service relay setting. (Yes/No)	Yes	
5.	3 terminal line differential 87L protection Communication architecture with BOM considered for all 220 / 110 kV lines (Yes/No)	Yes	
6.	DRCA system with industrial PC and its related accessories, LIU, switches, patch cords etc as mentioned in Automation specs considered per station	Yes	
7.	Type Test Report Submitted for all IEDs & MUs (Yes/No)	Yes	
8.	Bidder Meets Qualification Requirement given in Specs (Yes/No)	Bidder to mention	
9.	Preferred Vendor List: Deviation taken (Yes/No)	Bidder to mention	
10.	One Laptop per substation: HP make, 8GB RAM, 1TB Hard disk, Core i5, 2 USB ports, 1 HDMI port, 9-pin serial port along with standard accessories and laptop carrying bag (1 number per receiving station)	Yes	
11.	All relay, MU software's along with relevant data models, Gera types and connectivity packages are pre-installed in the laptop	Yes	
12.	In case of licensed software, bidder agrees to provide at least 10 nos of licenses or as many number of MUs / IEDs whichever is higher for purchasers use	Yes	
(IV)	**Spares**		
1.	Bidder shall supply 01 nos of each model number IED per substation as lose spare relay proposed in the respective station shall be supplied. Bidder shall account for this cost before final bid submission.	Bidder agrees	

Sl. No.	Description	Tata Power requirement	Bidder compliance
2.	Bidder shall supply 01 nos of MU of each AI, BI, BO configuration as spare. Bidder shall account for this cost before final bid submission.	Bidder agrees	

9 QUALITY REQUIREMENTS (QAP & SQP)

9.1 To ensure that a well-engineered and contractually compliant system is produced, **Bidder shall adhere to Approved Tata power SQP** for the preparation of all contract deliverables. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies.

9.2 QUALITY REQUIREMENTS: Bidder to prepare and submit Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) for approval of Owner to ensure that a well-engineered and contractually compliant system is produced. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies.

9.3 Tata Power Standard Quality Plan (SQP) and Field Quality Plan (SFP) are attached with this specification defining minimum inspection and testing requirements during shop and site inspection respectively. Bidder to ensure that these requirements are compiled in MQP and FQP submitted for approval.

Factory Acceptance Test (FAT)

a) The FAT at factory shall be done with simulation, testing of IEDs, merging units, scheme checks on 100% of panels including automation and communication products. The vendor shall provide enough resources if owner sends more than one team for simultaneous inspection of number of panels.

b) Owner approved MQP shall be referred for shop inspection. The purpose is to ensure that the Bidder has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab.

c) The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. Prior to release for shipment of the equipment the Purchaser or his representative will witness Factory Acceptance Test (FAT) in which the system is checked against the specifications.

d) Type and routine tests certificates shall be furnished. Tests for components shall be as per relevant standard specifications and approved MQP.

e) System tests shall be performed on the completely assembled system. Type, routine and optional tests covered in the approved MQP and this specification shall be conducted in addition to the system tests.

f) Bidder shall incorporate all FAT comments prior to despatch. After Bidder confirms that all changes have been incorporated, Purchaser's Office will issue Despatch Clearance.

g) The Test Reports as well as Test Certificates of OEM, third party, Bidder shall be submitted for approval / verification.

h) FAT and Despatch Clearance by the Purchaser shall not relieve the Bidder from complete responsibility for the total system and its performance subsequently.

10 INSPECTION, TESTING AND PERFORMANCE REQUIREMENTS ALONG WITH WARRANTY

a) Bidder should follow owner approved MQP and specification requirements.

b) All type test reports of IEDs, aux relays and all equipment's installed in CRP panel as per IEC standards mentioned specs in the shall be submitted for purchaser review along with technical bid.

Performance Guarantee Parameters

a) Satisfactory operation of the system offered shall be guaranteed for 5 years from the date of taking over of system by purchaser after SAT including trouble-free & intervention-free operation.

b) Bidder shall undertake to repair or replace any part, which is defective or unequal to the rated duties due to faulty materials, design or workmanship.

Warranty

a) The five-year warranty shall cover firmware and software upgradation. It shall cover complete performance of digital substations protection, automation and communication system over a period of 5 years.

b) Bidder shall warrant that the system design is free of defects in material and workmanship or faults in design, in so far as the equipment fails to meet the requirements of this technical specification, for a period of 60 months from the date of final acceptance by the purchaser after completion of 30 days trouble free operation.

c) With respect to defects in equipment part, Bidder's liability is to make good by replacing the faulty equipment. It is the responsibility of the Bidder to replace the faulty equipment within 30 working days.

d) The Bidder will cover the cost associated with the shipping of defective or failed items during warranty period. The new equipment, parts shall be delivered free of charge.

e) Bidder shall extend all warranties / guarantees to the purchaser, provided by sub-Vendors, of duration longer than that in this specification

11 MANDATORY SPARES

Bidder to provide substation wise list of Mandatory spares required for trouble free operation of CRP panels, if any.

12 TOOLS AND TACKLES

Bidder to provide relevant tools and tackles for condition monitoring / maintenance of CRP panels, if any.

13 DATA SUBMISSION BY BIDDER

12.1 Tender Purpose

Bidder shall submit the following information along with the Technical Bid of Sub-Station Protection and Automation Specific Submissions

12.1.1 Bidder shall provide the technical offer including data sheets, architecture etc., of hardcopies and soft copies for the technical evaluation. All datasheets of the BOM items shall be enclosed along with the technical offer. **In absence of technical data sheet, architecture drawing, detailed bill of material, detail GTP etc, the offer submitted by the bidder may not be considered.**

12.1.2 Dully filled in schedules, listed in section 'C'.

12.1.3 Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

12.1.4 System Architecture Drawing

12.1.5 Catalogues of the equipment's offered

12.1.6 The attached Bill of Materials (BOM) and datasheets enclosed with the specification are indicative. The Bidders are expected to submit the detailed BOM mentioning the quantity, make, model and warranty.

12.1.7 Product life cycle document for all supplied equipment.

12.1.8 Confirmation on lifetime, spares, manufacturing, onsite & Offsite technical support of the supplied equipment for the next 15 years

12.1.9 List of major relevant experiences of the Principal, Collaborator and the Product respectively.

12.1.10 Technical support facilities including qualified man-power, testing tools and instruments and integration facilities available within India.

12.1.11 The Bidder shall give an undertaking to provide full range of local services (including hardware and software maintenance, modifications and upgrade support) for the life of the delivered Sub-Station Automation system including Communication interfaces.

12.1.12 Bidder to submit all relevant test certificates for evaluation

12.2 After award of Contract

The following documents shall be submitted for Purchaser's approval during detailed engineering through Wrench system (Web based system of TATA Power). All drawings will be reviewed, commented and approved by TATA Power through Wrench system. Bidder shall nominate document manager for this activity and TATA Power will provide training on the same.

12.2.1 System Architecture Drawing

a. Network connections

b. Protocol used

c. Type of interconnecting cable

d. All MUs, IED's, workstations, gateways, network switches, etc.

12.2.2 Panel GA and Complete wiring diagram along with Trip matrix

12.2.3 Finalization of relay settings and configuration in consultation with Tata Power representative as per approved drawing and scheme

12.2.4 Detail Bill of Material listing; equipment designation, make, type ratings, etc. of all the equipment's supplied

12.2.5 Hardware and Software Specification & Manuals for all the equipment supplied including that of Third parties

12.2.6 Functional Design Document, Guaranteed technical, availability and reliability parameters

12.2.7 FAT & SAT procedures

12.2.8 DRCA I/O List as configured with address details

12.2.9 Interconnection Schedule (ICS) - Protection, Automation and Communication

12.2.10 All interoperability tables

12.2.11 Calculation for power supply, fuses/MCB, stabilizing resistors etc.

12.2.12 Logic Diagram (Hardware & Software)

12.2.13 Technical / Operator's Manual

12.2.14 IP addressing chart for all the IED's, network switches which are connected to the network

12.2.15 Other documents as may be required / applicable during detailed engineering

12.2.16 All drawings and data shall be annotated in English.

12.2.17 Bidder shall furnish four (4) hardcopies (plus 3 soft copies on reliable media) of all drawings along with manuals (Administration, Operation & Maintenance, Troubleshooting and Installation), Technical catalogues, Test Certificates and Acceptance Test Reports along with delivery.

12.2.18 Two copies of the internal test report, FAT and SAT documents with test protocol formats shall be submitted for approval. Approved FAT and SAT documents are one of the prerequisites of commencement of FAT and SAT. Bidder shall also furnish Original plus one copy of all System Software (OS and standard RTU/Gateway and other related software) along with delivery.

12.2.19 Bidder shall submit the final as built drawings & documents on AutoCAD & PDF format.

12.2.20 All licenses shall be valid for the entire lifecycle of the system supplied.

12.2.21 This list is indicative and will be finalized post award before the start of detailed engineering as MDL (Master Document List).

Annexure - PQR for Digital Substation

Bidders Prequalifiying Requirements for Protection, Automation & Communication System of Process Bus Based Digital Substation				
Sl. No.	**Parameter**	**Tata Power Requirement**	**Documents To be submitted by Vendor to ascetrain meeting of Pre-qualification requirement**	**Vendor submission against Tata Power PQR requirement**
1	Infrastructure	Bidder must be an OEM of Process Bus IEDs (Merging Units, Switch Control Unit), Protection & Sub-station Automation IEDs and Communication System, having manufacturing facility / assembly in India.	Self-undertaking to be submitted in this regard. Tata Power reserves the right to inspect the said manufacturing facility as a proof of compliance to this parameter.	
2	Supply and Experience	The bidder should have supplied minimum 1 number substation having line and transformer bays based on IEC61850 Process Bus for Conventional AIS/GIS with MUs and SCUs, Protection, Automation and Communication systems for 110 kV and above sub-stations with at least 10,000 Input-Output Points (of Gateways) for each project. The system supplied should have been in satisfactory commercial operation for a minimum period of 02 years as on scheduled date of the bid opening. Bidder shall offer latest software on open architecture and should have supplied these at least for 1 project in last 5 years. Protection and Sub-Station Automation must be from the same OEMs. Indian Subsidiaries of global companies having plant in India are also eligible to bid if the qualification requirements stated above are met independently or in combination with the parent company. Declaration from parent company needs to be submitted.	Supply List & Performance Certificates from the utilities / clients Self-undertaking to be submitted in this regard. TATA Power reserves the right to inspect the said manufacturing facility as a proof of compliance to this parameter.	
3	Type Test	The bidder shall submit Type test reports obtained from NABL/ International Accredited Lab for the equipment / material offered. The type tests should have been conducted on the equipment / material of the same design. The type tests should have been conducted within 5 years prior to the date of bid opening. Time period for type test may be extended by another 5 years as a special case, if there is no change in design / material of construction (MOC). In case the type test reports furnished are not for the quoted equipment / material but for the equipment / material with higher voltage class and/or different capacity, then type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material.	Type Test Report. Undertaking that there is no change in design / material of construction (MOC) if Type Test Report older than 5 years but less than 10 years prior to date of bid opening has to be considered (if applicable) Undertaking that type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material, in case type test reports furnished are not for the quoted equipment / material but for the equipment / material with higher voltage class and/or different capacity, (if applicable)	
4	EPC Experience (If applicable)	In case the package involves installation & commissioning of the equipment / material, then the bidder shall have the following experience: a) He should have successfully completed one single order of value ..... (80% of estimated value of similar work in last three years) OR b) He should have successfully completed two single orders of value ..... (50% of estimated value of similar work in last three years) OR c) He should have successfully completed three single orders of value ..... (40% of estimated value of similar work in last three years)	Performance Certificates from the utilities / clients	

SECTION B

CHAPTER - B2.3-B

TECHNICAL SPECIFICATION

FOR

“Sub-station Automation System”

Rev. No	Date	Revision History	Prepared By	Checked By	Approved By
R0	22-03-2021	Final release	VS	RSM	BSP
					B S Pisolkar

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1.0 INTRODUCTION

Tata Power Company Limited (Tata Power) hereinafter called the "OWNER" or "PURCHASER", proposes augmentation work at various Receiving Station (RSS) as mentioned in the RFP.

Bidder shall refer the entire project specifications to understand the execution methodology and interface equipment specification for the complete scope of work of this project. Bidder shall offer the Substation Automation System (SAS) Supply & Services accordingly.

The document covers the specific requirements for complete design, detailed engineering, installation, testing and commissioning of **Substation Automation System as per following**

a. Substation Automation System at Kolshet RSS.

b. Integration of Protection relays at various Receiving Sub-Stations with existing SAS system and SCADA as per the locations mentioned in the Protection specification (B2-3-A) & Section-A .

All equipment, system and services covered under this specification shall comply with all current applicable statutory regulations and safety codes in the locality where the equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder, unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility

2.0 BIDDER'S QUALIFICATION REQUIREMENTS & APPROVED VENDOR LIST

2.1 Approved Vendor List for Purchaser

Following Automation System Manufacturers are approved for supply and installation of Sub-Station Automation System.

a. M/s Siemens India Limited

b. M/s ABB India Limited

c. M/s GE (T&D) India Limited

Purchasers preferred list of vendor / sub vendor / OEM (Refer Annexure-I List of Preferred Equipment's), which is shared as part of Technical Specifications and the same should be adhered by the bidder.

2.2 Bidder's Qualifying Requirement

Bidder must meet all following qualifying criteria for Substation Automation Systems:

a. The bidder should have supplied minimum 20 nos. Protection, Automation and Communication systems for 110 kV and above sub-stations with at least 10,000 Input-Output Points (of Gateways) for each project. The system supplied should have been in satisfactory commercial operation for a minimum period of 05 years as on scheduled date of the bid opening. Bidder shall offer latest software on open architecture and should have supplied these at least for 5 projects in last 2 years. Protection and Sub-Station Automation must be from the same OEMs.

b. Indian Subsidiaries of global companies having plant in India are also eligible to bid if the qualification requirements stated above are met independently or in combination with the parent company. Declaration from parent company needs to be submitted.

c. Bidder must be OEM of protection relays, Sub-station Automation and Communication system, having manufacturing and testing facility in India.

d. The bidder shall submit Type test reports obtained from NABL/ International Accredited Lab for the equipment / material offered. The type tests should have been conducted on the equipment / material of the same design. The type tests should have been conducted within 5 years prior to the date of bid opening. Time period for type test may be extended by another 5 years as a special case, if there is no change in design / material of construction (MOC).

e. In case the type test reports furnished are not for the quoted equipment / material but for the equipment / material with higher voltage class and/or different capacity, then type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material.

f. EPC Experience (if applicable), In case the package involves installation & commissioning of the equipment / material, then the bidder shall have the following experience:

a) He should have successfully completed one single order of value **XXX** INR (80% of estimated value of similar work in last three years) OR

b) He should have successfully completed two single orders of value **XXX** INR (50% of estimated value of similar work in last three years) OR

c) He should have successfully completed three single orders of value **XXX** INR (40% of estimated value of similar work in last three years).

3.0 SYSTEM DESCRIPTION AND SCOPE

The scope of work shall include but not be limited to the following:

3.1 The BIDDER shall consider scope for design, engineering, manufacture, procure, inspect/test at manufacturers works; deliver to the site, do erection, installation and testing, commission and hand over of a complete Substation Automation System (SAS) based on IEC61850 standards along with all its components and auxiliaries as described in sections below, integrations with other existing / third party systems etc. including integration of Protection IEDs, condition monitoring devices with Gateway to Purchaser's SCADA Systems on IEC104 protocol.

The scope of SAS includes, in minimum, the following:

a. Pre-wired RTU Panel

b. Ethernet Switches

c. Networking accessories viz. Networking panel for SAS, 4 Port I/O boxes with Quad face plates, RJ45 connectors, Patch panels, FO & CAT6 patch chords, FO & CAT6 armoured & unarmoured cables, LIUs, RS485 armoured & unarmoured communication cables etc.

d. Redundant Gateway system with Layer-3 Switches for SAS at Kolshet RSS

e. System management Software's and tools

f. Other components and accessories, hardware, software and firmware, to interconnect and integrate the above items into a common fully functional system.

g. Spares

h. Process Bus Panels & Station Bus panels for Digital Bays(Optional)

3.2 The offered SAS system/solution shall be from single OEM and the entire automation products shall be from the same OEM family/ same SAS product series. Bidder cannot offer multiple product from Same OEM/multiple vendor to meet the design requirement.

3.3 The protection IEDs shall be on Fiber Optic based communication and shall be integrated to the existing Gateway on IEC61850 protocol (Refer the Protection specification for more details)

3.4 The Pre-wired RTU panel will be integrated with existing Gateway either on IEC104 or IEC61850 Protocol .The protocol shall be finalized during detailed Engineering.

3.5 Bidder shall consider Ethernet switches, Cables, Termination boxes, Patch cords and other networking accessories accordingly in their scope. Bidder shall consider the communication equipment either in the protection panel or in a separate network Panel (2200x800x800mm). The same shall be finalized during detailed engineering.

3.6 Protection function such as Carrier IN/OUT, Diff IN/OUT, LBB IN/OUT, A/R IN/OUT, OLTS IN/OUT,86 OPERATED/RESET etc., shall be on soft and shall be integrated on IEC61850 protocol with existing Gateway along with other protection functions. However, Critical alarms such as Trip Circuit, Trip Relay Healthy, IRF,AC/DC supervision shall be hardwired to Misc. RTU panel.

3.7 Protection relays will be time synchronized with existing GPS receiver of the respective Stations. All existing GPS receiver supports SNTP/ NTP protocol.

3.8 Integration of proposed protection IEDs with existing Disturbance Record Collector Cum Analyzer (DRCA) systems at Station level as well as Purchaser's centralized DR system. The technical scope includes Auto DR, Relay parameterization, configuration management, fault record collection & analysis.

3.9 All necessary hardware, software or any other item required and not covered in the RFQ & BOM for successful commissioning of the Sub-Station Automation system; shall be arranged and supplied by the Bidder as a part of the scope adhering to the quality norms as per the direction and the satisfaction of the Purchaser.

3.10 Bidder shall consider Services from the Gateway & DRCA OEMs for configuration, testing & integration with Unified SCADA System.

Sl.no	Station Name	Gateway Make & Model	DRCA Make & Model
1	Kolshet	ABB (APPSIL) & MicroSCADA	Kalkitech & Syn3000& RAS

Table-1

3.11 The Auxiliary relay for the Digital Outputs shall have minimum 2 Normally open (NO) Contacts and both the NO contacts shall be connected in the series.

3.12 All DO Output terminal blocks (output contact from Aux.relay) shall be mounted vertically, links when dropped should isolate the control circuit and the field cables will be connected at the bottom of the terminal block. Bidder shall consider the suitable size of Cable Trough (Both vertical & horizontal) and routing accordingly. The Cable trough should have minimum 50% free space to cater the field cables.

3.13 It is bidder responsibility to design the panels and propose to Purchaser considering all maintenance aspects viz. free access to the equipment, removal during repair/failure, Field wiring/cabling. Also, Bidder should also take care the Equipment wiring, routing of cable, wiring from equipment to Terminal blocks etc. with enough length and appropriate lugs & appropriate labels for equipment & Cable identification.

3.14 Bidder shall ensure the Segregation of network (VLANS) with proper configuration, inbound and outbound network filtering on all the interfaces. Separate network shall be established for each function defined in the specification and including protection System.

3.15 Bidder shall provide all the necessary cables, termination kits and accessories for commissioning of Sub-Station Automation system. Cable supply, laying and termination for powering up and networking of the supplied equipment's and connectivity to the Masters (within the premises).

3.16 All FO/CAT6 cables for inter and intra panel shall be armored/unarmored for integration of IEDs.

3.17 All Inter panel wiring shall be through cable conduit. All FO patch cords shall be ruggedized.

3.18 Bidder shall submit single Signal list (I/O list) and ICS for Substation Automation for the entire station. The ICS shall include details of either ends terminal numbers, cable type, cable size etc.

3.19 Bidder shall consider and supply the Universal IEC61850 configuration tools for configuration, parameterization, maintenance and troubleshooting of offered IEDs and gateway.

3.20 All software supplied shall be licensed and shall be in the name of the Owner. Bidder should offer the latest software & Firmware of the SAS products which is tested and proven. Bidder shall provide all documentation in soft/ hard form about licensing information for each software supplied (OS, application software's of IED, other Application software's, configuration, diagnostics, simulation & testing tools).

3.21 Bidder to submit the architecture drawing and indicative bill of material along with the offer.

3.22 Demonstration / Testing of the fully configured system at Bidder's works before dispatch of the system at site (FAT). The factory inspection shall be integrated FAT of protection, automation and communication system at a common work place. FAT will be conducted as per the FAT procedure document to be submitted by the bidder during detailed engineering and approved by Owner after review.

3.23 Installation, testing & commissioning of the system including integration and configuration with Purchaser's existing systems, sub-vendors' systems & other systems and performance.

3.24 Submission of technical documentation related to design, construction/as built, testing, operation & maintenance of the equipment and submission of Test Reports, job progress reports etc. in hard copies (4 sets) and soft copies (3 sets, in PDF & AutoCAD).

3.25 Site Acceptance Test (SAT) to the Purchaser's satisfaction (as per the SAT document submitted by the bidder during detailed engineering and approved by the owner after review) with the completion of the following, in minimum:

a. Testing of the proposed Sub-Station Automation System from the Purchaser's SCADA systems.

b. Demonstration of system response

c. Integration of all supplied equipment under the contract.

3.26 Supply of recommended and mandatory spares for all supplied items as mentioned in the separate section.

3.27 Bidder shall provide 5 years of warranty for the supplied Substation Automation products including the 3rd party items viz. Ethernet Switches, Convertors, GPS system etc., Bidder shall consider the scope for warranty as specified in the specifications & share the warranty details including third party items as specified above

3.28 Maintenance of the system during warranty period and post warranty maintenance as specified. Providing software upgrades and modifications.

3.29 Any interoperability issues/integration issues arising during commissioning and during warranty period, bidder shall undertake to resolve them within 2 months (maximum) period without any cost implication to the Purchaser. In case the issue persists more than 2months, Purchaser shall be have right to take any action (either alternate technical solution suggested by Purchaser or Commercial implications) on the vendor.

3.30 Indicative I/O list, Bill of material and Data sheets attached in this specification are only as a reference for bid purposes. Details provided in these documents are minimum requirement of the purchaser. It is the responsibility of the bidder to meet the functional requirement as specified in the specification.

3.31 Unless specified otherwise, Bidder shall consider the products of quality, industrial grade & reputed make with replacement warranty, spares availability & maintenance support as per this specification document which applies for all SAS items.

Bidder shall note that, it is not the intent of this specification to specify completely herein, all details of design & construction of Sub-Station Automation system. However, the bidder shall include and supply the required material and resource at any stage of the project for successful and complete commissioning of the system.

4.0 CODES AND STANDARDS

The design, manufacture and performance of the Sub Station Automation System shall comply with all the requirements of the latest editions of international codes and standards applicable. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Emissions Standards		
1	EN55011 (CISPR 11)	ISM RF Equipment – Electromagnetic Disturbance Characteristics
2	60255-25	Electromagnetic emission tests for measuring relays and protection equipment
3	61000-3-2:2000	EMC-Limits for harmonic current Emissions.
4	61000-3-3:1994+2001	EMC Limits-Limitations in voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.
Immunity Standards		
1	61000-4-2 1995-01 60255-22-2 IEEE C37.90.3	Electrostatic discharge (ESD) immunity test
2	61000-4-3 1998-11, 60255-22-3 IEEE C37.90.2 (10V/m)	Radiated, radio-frequency electromagnetic field immunity test
3	61000-4-4 1995-01, 60255-22-4, IEEE C37.90.1	Electrical fast transient/burst immunity test
4	61000-4-5 1995-02	Surge immunity test

5	61000-4-6 1996-03	Immunity to conducted disturbances, induced by radio-frequency fields
6	60255-22-6	Electrical fast transient/burst immunity test
7	61000-4-81993-06	Immunity to power frequency magnetic fields
8	61000-4-12	Oscillatory waves immunity test
9	1995-05, 60255-22-1, IEEE C37.90.1	(Damped Oscillatory and Ring wave)
Safety		
1	61010-1	Harmonized Safety Standard
2	60255-5 2000-12	Insulation coordination for measuring relays and protection equipment- Requirements and tests
Power Supply Standards		
1	61000-4-11 1994-06	AC Power supply interruptions
2	61000-4-16 1998-01	Immunity to conducted, common mode disturbances.
3	61000-4-17	Ripple on D.C. power supply
4	61000-4-29+2000-08, 60255-11	Voltage dips, short interruptions & voltage variations on D.C. input power port immunity test
Environmental Standards		
1	60068-2-1 1994-05	Environmental Testing Cold
2	600068-2-2 1974	Environmental Testing Dry Heat
3	60068-2-6 1995-03 60255-21-1	Environmental Testing Vibration tests (sinusoidal)
4	60068-2-27 1987	Environmental Testing Shock
5	60068-2-29 1987	Environmental Testing Bump
6	60068-2-30 1980	Environmental Damp Heat cyclic (12+12 hour cycle)
7	60068-2-31 1969	Environmental Testing Drop and Topple
8	60255-21-2	Shock and bump tests
Communication Standards		
1	61850-3 IEEE 802.3 CSMA/CD	Substation Comm. Standard access method and physical layer specifications
Cyber Security Standards		

1.	IEC62351	Security in Automation Systems
2.	IEC 62443	Cybersecurity standards are multi-industry standards listing cybersecurity protection methods and techniques

The proposed automation system shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

5.0 DESIGN REQUIREMENTS

5.1 The Substation Automation System shall be designed such that it facilitates both local and remote monitoring with priority for remote monitoring. The Substation automation system shall enable complete unmanning of the sub-station and allow for complete remote monitoring and control from Purchaser's Power System Control Center (PSCC)

5.2 The Automation system design shall be based on distributed architecture with central monitoring and control in line with existing Unified SCADA and SAS implemented across Purchasers sites.

5.3 The systems shall be State-of the art system; based on IEC61850 standards for operation under electrical conditions present in high-voltage substations.

5.4 All SAS components supplied as a part of this specification shall be industrial grade suitable for 24x7 operations and equipment shall be selected accordingly by the bidder.

5.5 Bidder should offer the latest software, firmware of the equipment which tested, proven and in service.

5.6 The offered product shall comply to all open protocols such as IEC 61850, C37.94 (Tele-protection), etc. and compatible with all other OEM's products. Any interoperability issues arising during commissioning and during guaranty period, bidder shall undertake to resolve them within 2 months (maximum) period

5.7 The Bidder shall follow the latest engineering practices & ensure compatibility requirements, continuity of equipment supply and the safety of the personals. All required safety interlocks and fail-safe logics shall be incorporated in the system wherever required.

5.8 Redundancy shall be ensured in terms of processor, ports and path of communication to ensure reliability & availability. There shall be no single point of failure in the system.

5.9 All substation automation system shall be designed with 48VDC redundant power supply. However, Using of AC-DC Converter (UPS to 48VDC) and or DC-DC Converter (Station Aux to 48VDC) or direct 48V DC shall be finalized during detailed engineering.

5.10 All Automation Panels shall be provided with redundant Diode OR-ing units and DC-DC converters (Shall be finalized during detailed engineering).

5.11 All protection and automation system shall be time synced and shall have the same reference time i.e. from the station GPS. The station GPS shall have multiple SNTP/ NTP ports to synchronize the systems.

5.12 The system shall be designed such that maintenance, modification or extension of components shall not cause a shutdown of the whole system.

5.13 The system shall be self-healing without human interventions. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

5.14 The systems shall be modular in nature and shall be capable for expansion to meet future requirement.

5.15 The substation automation system shall be designed and implemented using the best Cyber Security practices. The system shall provide in minimum the following features viz. Authentication, Authorization, Audit Trails, Network segregation, backups, ports hardening, virus/malwares/ransomware prevention, intrusion prevention and detection.

5.16 All Automation Panels will have Louvers & Fan arrangement (min.2 nos). The Panel shall be either front Swing frame or front fixed and the rear side shall be double door type. The Panel IP class shall be IP55.The Panel shade shall be Siemens Grey (RAL 7032).

5.17 **110 kV system**

a. The Protections relays shall be integrated to 110kV Gateway on IEC 61850 protocol.

b. Physically independent communication networks shall be considered **for Main-1 & Main-2** Numerical Relay (incase). Adequate switches for NR end along with panels/mounting arrangements shall be considered

c. All these independent networks shall be connected to the switches in the Gateway panel.

d. The Gateway shall have separate ports for communication to the Automation WAN (Station L3 switches).

e. The Gateway configurations shall be done in such a way that the system shall report to four independent redundant masters (Unified SCADA, Emergency Control Center, Nodal SCADA, Quality Assurance System) on IEC60870-5-104 Protocol.

f. All DI signals shall be terminated in knife edge type TBs CKT4U or equivalent. For DO signals stud type droppable links (CBT4U or equivalent) shall be used. Interposing relays (Omron make MM4XPD for Breaker control and MM2XPD for other DO signals) shall be used for all DO signals.

g. In Pre-wired RTU panels,2 Normally Open (NO) contacts of Auxiliary Relay in the DO circuit shall be wired in series.

5.18 **Disturbance Recorder Collector and Analysis system (DRCA)**

a. All Numerical relays shall integrate to existing DRCA system through the Bay level switches/Network Panel.

b. The Station DRCA shall become part of the Centralized DRCA system to enable automatic downloading of DR files and remote parameterization.

5.19 **Relay integration with SAS as per Protection Specification mentioned under Section B, Chapter - 2.3-A**

a. All numerical relays supplied as part of this project shall be integrated to the existing Gateway on IEC61850 at Respective Remote ends.

b. Protection related hardwired signals shall be integrated to the Protection Misc. RTU.

5.20 Health monitoring /watch dog contacts of active components (IEDs, Switches, Converters etc.) shall be wired up to the terminal blocks of the respective panel and shall be further integrated with Miscellaneous RTUs

5.21 All Main MCBs shall have auxiliary contact for monitoring the status

5.22 All Fiber/CAT6 cables for inter and intra panel shall be armoured, unarmoured for integration of IEDs. All Inter panel wiring shall be through cable conduit

5.23 Bidder shall consider the Ethernet Switches, Communication cable & Ruggedized FO Patch cords and accessories accordingly.

5.24 **Safety in Design:**

a. All IED viz. RTU, BCU, Gateway shall have Select before execute for equipment control, Single command execution at a given time for equipment control

b. All required safety interlocks and fail-safe logics shall be incorporated in the system wherever required.

c. Feedback of the equipment before and after control, in absence of equipment status feedback, controls are blocked

d. Control Command time out in case of long ideal state. All Control commands shall de-energised in case of re-booting the RTU/BCU/Gateway.

e. Disconnected Terminal blocks for safety isolation, Control command links shall be vertically mounted, Series contacts used in Aux. relays for equipment Control.

f. Ensuring Breaking mechanism (Fuse, MCB) in all equipment Schematic in case of abnormal conditions.

g. Opto-coupler isolation for all DI/DO/AI cards

h. Selection of Panel with appropriate IP Class – (e.g. IP54 (dust-proof with rodent protection))

i. All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame-retardant material and shall not produce toxic gasses under fire conditions.

j. Equipment's should comply to Cybersecurity aspects required under SAS.

6.0 LAYOUT REQUIREMENTS

6.1 All systems shall be installed based on the approved equipment layout and plot plan.

7.0 OPERATIONAL AND MAINTENANCE REQUIRMENT

7.1 OPERATIONAL REQUIREMENTS

a. The system shall be user-friendly and suitable for remote operations and control from existing/new Unified SCADA system.

b. Any failure or disturbance in the substation shall be annunciate to PSCC via the SCADA system as per Tata Power's operation philosophy.

c. The system shall facilitate safe and secure operations of all the equipment.

d. Wherever local and remote operations are possible, selector button shall be made available both in local as well as remote. The selection of local/remote mode of operation shall be reported to the SCADA system.

e. Proper Rating of MCB, Power supply Units, Converters etc, to be selected. Appropriate & suitable lugs, wires and terminal blocks to be selected during design of Panel & Equipment.

f. Opto-coupler isolation for all DI/DO/AI cards along with LED indication for each input & Output

7.2 MAINTENANCE REQUIREMENTS

a. Bidder shall provide facilities for carrying out online and offline maintenance of the components supplied as a part of the system. In general, this should include adequate testing equipment, tools, safety devices and other accessories. Bidder shall provide the details in their bid.

b. Bidder should provide Maintenance strategy of the product being offered so as to schedule appropriate timeline for maintenance.

Warranty :

a. Bidder shall warrant that the equipment including software, hardware, firmware and associated documentation are free of defects in material and workmanship and from defects or faults in design, in so far as the equipment fails to meet the requirements of this technical specification, bidder to adhere to the warranty of 60 months from the date of final acceptance by the Tata Power after completion of 30 days trouble free operation.

b. With respect to defects in equipment part, Bidder's liability is to make good either by repairing or replacing the faulty equipment (prefers a replacement by Purchaser). It is the responsibility of the Bidder to replace the faulty equipment in warranty within 7 working days. In case any

failure of equipment which affects operations, Bidder shall arrange for stop gap/interim hardware/equipment arrangement to Purchaser's operational requirement till the defective material is getting repaired/replaced.

c. After replacement of the faulty equipment, the purchaser shall return parts that are defective to the Bidder. The Bidder shall cover the cost associated with the shipping of defective or failed items during warranty period. The new equipment, parts shall be delivered to the purchasers facility CIF (Cost, Insurance, and Freight) free of charge.

d. During the warranty period, the bidder shall upgrade the firmware of the modules with the latest available. This activity shall be carried out free of cost at site as and when the patches are released. Sample testing for the operation of devices and associated equipment shall be carried out after the Up gradation of any software upon agreed by the purchaser.

e. With respect to software, the Purchaser shall notify the problem to the Bidder, including a detailed description of the deficiency and associated condition. Bidder shall guide the purchaser for corrective action. If the same is not resolved, the Bidder shall depute his personnel to attend the same within 24 hours from the time of reporting the problem. The system Bidder shall be fully responsible to resolve hardware and software deficiency reported by the purchaser.

f. With respect to third-party software and consumable parts supplied, the Bidder shall make reasonable effort to obtain the best warranties possible from the sub-Vendor thereof and assign to the purchaser any such warranties to the extent that such warranties may be assigned to the purchaser.

g. Bidder may consider longer warranties than included in these specifications.

h. Bidder shall extend all warranties / guarantees to the purchaser, provided by sub- Vendors, of duration longer than that in this specification.

Upgrades & Modifications

a. Bidder shall continuously keep the Owner informed of all Software and Hardware upgrades as & when these are released through advisories/ mails.

b. Bidder shall supply upgrades of all installed software (both own and third party) for a period of five years from the date of system acceptance without any commercial implication.

c. Bidder shall rectify all design defects and software bugs at no extra cost for a period of 5 years from the date of system acceptance

d. Bidder shall provide lifetime support (15 years) for the system, even if no upgrades are implemented.

e. The system referred to above includes Bidder's own as well as third party components.

f. Bidder shall port the supplied software onto upgraded hardware (as per Bidder's standard offerings) without additional Software License Fees.

Support Services

g. Bidder shall have support service Centre in India to cater after sales services. Technical support facilities including qualified manpower, testing tools, instruments and integration facilities available within India

7.3 **TRAINING REQUIREMENT**

a. Bidder shall provide training to the Purchaser's personnel on the configuration, operation and maintenance of the system supplied including Non-OEM equipment/3rd Party equipment. The training shall cover development, integration, installation and commissioning of both software & hardware components of the system.

b. Bidder to consider minimum 30 man-days training for Purchaser's personnel for automation systems.

c. The Bidder shall provide Classroom as well as hands-on training on the system. All required training materials such as system catalogues, test instruments, demo equipment, and simulation jigs, etc. shall be provided by the Bidder. The training shall equip the Purchaser's engineers for installation, commissioning, operation and post-warranty maintenance of hardware, software (Operating System, Administration and Applications), protocols and all third-party systems viz. Ethernet switches and converters etc.,

d. All clauses related to Transport, Lodging & Boarding, Local transport for Owner's personnel etc. shall be as per the terms and condition defined in the GCC/Section-A.

e. Factory training shall be immediately prior to FAT. Site Training shall be prior to commissioning on a mutually convenient schedule.

f. Bidder shall indicate their Training facilities including test tools and simulation facilities. Bidder shall provide the training calendar & details of topics considered for the equipment offered.

g. General requirements relating to the training are specified below:

i. Personnel who speak understandable English and who are experienced in instruction shall conduct training courses.

ii. Bidder shall provide all necessary training material. Each trainee shall receive individual copies of the technical manuals and pertinent documents.

iii. The Purchaser shall be permitted to video tape all training classes.

iv. Class materials, including documents sent before the training classes and class handouts, shall become the Purchaser's property. The Purchaser may copy this material for in-house training and use only.

v. Training sessions shall accommodate the number of candidates as per the contract.

8.0 TECHNICAL PARAMETERS OF EQUIPMENT INCLUDING DATA SHEET

8.1 **Pre-wired Miscellaneous RTU Panel**

The RTU unit shall use industrial grade components and shall be same of BCU family. The remote terminal unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of analogue signals. It shall incorporate select-before-operate control principles as safety measures for operation via SCADA System. They shall perform all sub-station related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording, arithmetic, logical and trigonometric calculations and shall provide inputs for status indication and outputs for commands. The RTU shall acquire and process all data of the field (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the SCADA system either directly or through gateway. The remote terminal unit shall have the capability to store all the time stamped data at least for 30 days.

The individual/group of circuits/equipment of the power system network are controlled and supervised from dedicated lower level I/O modules in remote terminal units (RTU). The number of I/O modules shall be provided for control and supervision of all circuits / equipment of the entire power system network as specified against items mentioned in the BOM.

Pre-wired RTU panel (2300mmX800mmX800mm) along with signal conditioning interfaces, terminal blocks/Field interface module and auxiliary relays shall be provided for miscellaneous input/outputs from non-microprocessor-based relays/IEDs and for supervision and control of station auxiliary equipment's.

The system shall comprise the following in-built sub-system namely failsafe control (i.e. in built check-before-execute feature), Interlock and Sequential Logic Control system, Sequence of Event Recording (SER) system and Fault Disturbance Recording System (FDR), Interfacing with third party IEDs (e.g. Multifunction Meters, condition monitoring equipment etc.), interfacing with third party computer system, Integration of data as per time base (e.g. 15 minutes integration of energy data per feeder), direct GPS clock connectivity, through SNTP server or through the Gateway (main and standby mode) for time synchronization. RTU shall support redundant time synchronization inputs.

The RTUs shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

All analogue/digital parameters related to auxiliary system, protection devices, which cannot be directly communicated to the Gateway shall be interfaced with Protection & Miscellaneous RTU such as following, but not be limited to:

a. ACDB, DCDB, Battery Charger etc current, voltage, status.
b. Fire Alarm signals, HVAC signals etc.
c. Hardwired Protection signals (Auxiliary)
d. 415V system alarms, control and Analog signals

e. UPS, fire-fighting system, etc.

f. All automation panel & equipment's - power supply & health monitoring

The following scheme / features shall be available:

1) The Input / Output capacity of RTUs shall cater all specified requirement.

2) The System shall be based on a decentralized architecture and on a concept of function-oriented, distributed intelligence.

3) The RTU shall be suitable for control, monitoring and protection of circuit breakers, disconnectors and earthing switches for all types of switchgear configurations up to the highest voltage levels.

4) The RTU shall be with min **5000 I/O tags.**

5) RTU communication protocol shall be configured to report analog & Status changes by exception to master stations. However, RTU shall support periodic reporting of analog data and periodicity shall be configurable from 1 sec to 1 hour. Digital status shall have higher priority than the analog data. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit.

6) All status inputs shall be scanned by the RTU at 1 millisecond periodicity.

7) The standard 19" modular case of the RTU with a user-selected number of plug-in modules shall provide a flexible solution for easy integration of the devices into the substation.

8) XML and SCL configuration interfaces shall allow information to be shared between the various configuration tools, reducing the overall engineering time.

9) For IEC 61850 compliance, the device shall be test certified by KEMA or equivalent laboratory.

10) The device shall have PICS, MICS & TICS & PIXIT files.

11) It shall support device interoperability using IEC 61850 & GOOSE Communication

12) The RTU shall support programming language (Functional Block) with arithmetic & logical functions to incorporate Interlock Logic for SCADA Controls. Bidder to ensure supply of necessary hardware and software to achieve the functionality.

13) RTU shall be capable of communicating to Gateway.

14) All transducers mA/mV DC measurement (various ranges of DC current, Voltage) of electrical and non-electrical quantities such as Transformers Winding Temperature, Oil Temperature and Tap Position shall be wired to the Misc. RTU panel. Bidder shall consider all necessary transducers for the parameters, other than analog parameters available from the Multifunction Meters.

15) RTUs shall be time synchronized with the GPS clock on SNTP protocol or on IEEE 1588 V2 protocol, and subsequently RTU shall synchronize all its slave IEDs.

16) Digital inputs/outputs from/to Electromechanical Relays, if any, shall be connected to the miscellaneous RTU.

17) Digital inputs/outputs from/to auxiliary system, SCADA equipment's, shall be connected to the miscellaneous RTU. Potential free contacts of health check (such as failure of communication, power supply & CPU) shall be provided for RTUs, Gateways, Communication equipment; shall be wired to miscellaneous RTU panel.

18) The RTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The RTU shall be set to capture contact operations of 10 msec or more duration. Operations of less than 10 msec duration shall be considered no change.

19) To take care of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed, the status change shall not be accepted as valid.

20) User friendly on-line health and data monitoring facility shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool – Laptop).

21) The Master Station user shall be able to perform a virtual connection with any RTU/IED through Gateway, provided by the communication protocol functionality, to support the information transfer from and to the RTU/IEDs. For example, the Master Station shall gather on-demand IED data; visualize IED configuration parameters, and IED source code depending upon the IED capabilities. On the other hand, the Master Station shall be able to download to the RTU/IEDs configuration parameters, code changes, etc. depending upon the capabilities of the offered system.

22) At station level, the entire station shall be controlled and supervised from the Purchaser's SCADA System. Clear control priorities shall prevent operation of the equipment at the same time from more than one of the various control levels, i.e. SCADA system at MCC, BCC, ECC and Nodal, or equipment level. The priority shall always be on the lowest enabled control level.

23) The RTU shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of RTUs shall be compatible with the overall system communication and data exchange requirements.

24) In case of power supply failure, auto start-up and restoration of the RTUs shall be possible without manual intervention.

25) RTU shall provide Programmable DO, DI, LED based on IEC61131-3.

26) RTU shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850 and other IEC standards. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

27) RTU shall offer Binary input processing (Single point, double points, multiple points, system input and logic input), all acquired, and time stamped at <1 msec accuracy and discrimination.

28) Bidder to consider Auxiliary relays (OMRON/OEN/Paramount) for digital outputs as per the quantity mentioned in the BOM.

29) 2 Normally Open (NO) contacts of Auxiliary Relay in the DO circuit shall be wired in the series.

30) The optocoupler input voltage of DI and DO shall have a wide range of DC input voltage from 48 - 250 VDC.

31) All exposed portions (if any) of the RTU shall be covered with protective cover.

32) The field wiring shall be terminated such that these are easily detachable from the I/O module without disconnection of the field cables.

33) Remote database downloading & uploading of RTU from master station shall be available.

34) It shall be possible to increase the number of communication ports in the RTU by addition of cards, if required in future. The RTU shall support the use of a different communication data exchange rate and scanning cycle on each port and different database for each master station.

35) Internal battery backup to hold data in SOE buffer memory, time & date.

36) The proposed RTU shall be SSL/VPN, NERC/CIP compliance.

37) The BCU database shall be MS-Excel based for easy configuration, export & import of database file.

38) The characteristic of the contact outputs per signal/command shall be adjustable via software:

i. Latched

ii. Non latched

iii. Time delayed reset

39) **Communication**

Ports

a. A galvanically isolated USB port for local engineering through laptop.

b. 8 nos. RS 485 port, 2 nos. RS 232 port

c. 2 Nos. Fiber optic port or Redundant Ethernet port 100/1000 MBPS, with dual active depending on the proposed configuration

Protocols

Communication protocol IEC 61850, IEC 60870-5-103, IEC60870-5-104 (Master & Slave), MODBUS (Serial & TCP), SNMP v1, v2c and v3 and SNTP / IEEE1588 V2 with Server and Client license shall be available. The RTU shall meet the IEC 61850 standard in every respect and interoperability with other manufactures IEDs and tools shall be verified. Master and slave license shall be provided for all the above-mentioned protocols.

40) **Algorithm and Logic**

a. The RTU shall be based on advanced and proven algorithms for writing interlock logics, so an easy and efficient upgrade of the RTU functionality shall be possible.

b. The interlock logics shall be User interface based (or) Functional block diagram based.

c. Necessary advanced logical & arithmetic functions shall be available.

d. Interlocking modules for all types of switchgear arrangements shall be available in order to avoid damaging switchgear operations and to ensure personal safety.

e. The RTU shall support interlocking via station bus and/or hardwired solutions.

f. RTU shall facilitate user defined logic functions such as automatic control sequences by means of available logic elements. For example, with one command perform a safe change of the connection of a selected line from one busbar to another busbar in double busbar switchgear.

g. Command is always to be given in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated (Select-before-execute).

h. It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers).

i. A delay/integrator shall allow the pick-up and reset of binary signals to be delayed before being displayed or used to control other functions.

41) **Self-Supervision**

a. The RTU shall have extensive self-supervision including all I/Os and communication channel.

b. The RTU shall have LEDs for healthiness / error indication

c. RTU shall have the facility to generate and download the log files for maintenance and troubleshooting.

d. Each RTU shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the equipment of the station.

e. Command execution timer (configurable) must be available for each control level point. If the control action is not completed within a specified time, the command should get cancelled (Run Time Command cancellation). The timer for this command time-out feature shall also be configurable.

f. In case of restoration of communication links, power supply after failure, the software along with hardware shall be capable of booting automatically & synchronize with the remaining system without any manual intervention.

g. It shall be possible to re-boot the BCU through the LAN/WAN from a remote location.

42) **Disturbance & Event Recording**

a. An event recorder that can handle up to 2000 time tagged events shall be included. Events shall be stored in non-volatile memory.

b. The RTU shall have an internal clock with the stability of 10 PPM or better. The RTU time shall be set from time synchronization messages received from GPS Receiver/Gateway. SOE time resolution shall be 1ms or better.

c. The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the RTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. SOE shall be transferred to Master Station through gateway as per IEC 60870-5-104 protocol.

d. It shall be possible to retrieve the recorded event on the Purchaser's SCADA system.

e. All recorded disturbance data from the RTUs shall be automatically uploaded (event triggered or once per day) to a Purchaser's SCADA Systems.

43) **Control and Monitoring**

a. The system shall incorporate the control and monitoring, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

b. Supervision of mA input signals from transducers shall be possible to include.

c. Raise and lower operation of OLTC taps of transformer, Control of protection relay systems in or out of service shall be available through RTU.

d. The operation shall depend on the conditions of other functions, such as interlocking, etc.

e. The analogue values acquired/calculated from multifunction meter shall be available to SCADA System. The abnormal values must be discarded. The analogue values shall be updated every second. The RTU shall convert the raw data from the MFM to an engineered readable value and send it to the SCADA systems. RTU shall be capable of acquiring 32 bit analog and accumulator data from Multi-function meters/Numerical relays on MODBUS/IEC60870-5-103.

f. The commands are always to be executed in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated.

44) **Power Supply**

a. Redundant Power supply module of 48 V DC +/- 20 % shall be available. Bidder shall consider the redundant DC-DC (110/220 V DC ~ 48 V DC) converter and add-on NO contact on each MCB's. Provision of two 110/220 V DC feeder shall be made available by the Purchaser from the DCDB. Same shall be finalized during detailed Engineering.

b. The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the RTU internal logic from being damaged and becoming unstable causing mal operation.

45) **Time Synchronization**

a. **Time synchronization interface:** The unit shall be capable to synchronize the internal RTC via communication ports on SNTP or on IEEE1588 through GPS clock.

b. In absence of direct synchronization signal from GPS receiver, the RTU shall be synchronized through gateway.

c. **Timing Accuracy:** The RTU shall time-tag event reports to an absolute accuracy of ***10 µs or better***. RTU at different system locations shall have the same absolute minimum timing accuracy.

46) **Environment requirements, Reliability & Cooling**

a. The panels shall be installed in switchgear room or in relay room with no temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from 0 to +65-degree C with rate of temperature change of 20-degree C/hour and relative humidity 95%, non-condensing.

b. The Unit shall have high reliability in operation and shall not use cooling fans. The unit shall have vermin proof enclosure and shall insulate electronics, internal components and electronics from external environment in order to avoid failures due to dust, condensation, humidity, fungus etc.

47) **Expansion in future**

Extension possibilities with additional I/O's inside the RTU unit or via Fiber optic communication and process bus. The RTU shall also support sub-rack arrangement.

48) **I/O Sub Systems**

a. Hot replacement of all I/O modules.

b. A complete set of process interface

c. High disturbance immunity, meeting the requirements of the IEC directives 89/336/EEC and 73/23/EEC when placed in cabinets.

d. Comprehensive self-diagnostics

e. On-board processing capabilities such as time-tagging, event handling, filtering and gain control.

f. Shall supports transparent dual redundancy

g. Modularity, permitting step-by-step expansion

h. Reliability and auto-diagnostics

i. Easy to configure.

j. Quick fault finding with help of LEDs of each module and channel

k. support of dual redundancy in power supply

l. The relative time error between events (DI signals) handled within one controller shall be <1 ms (interrupt driven). The relative time error between events handled within separate controllers shall not be more than 2 ms.

49) **Engineering Functions**

a. A tool for user friendly engineering and disturbance handling shall be available.

b. Configuration of all input and output logical signals and binary Inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

c. It shall be possible to access the RTU remotely from the Master Station for configuration/maintenance activity. The bay control shall have multilevel passwords to safeguard bay control, logic, and automation settings.

d. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool- Laptop)

e. The configuration software should be able to configure control, protection, inputs, outputs, etc. The software should also have provision to view all the electrical parameters. Actual conditions of all inputs, outputs, protection and control elements.

f. The software should allow configuration of the IED with different versions.

g. It should be possible to configure the IED for its protocol settings.

h. For IEC 61850 protocol, the ICD file generation should be possible through software.

50) **Cyber Security**

a. Secure access- Level Wise enabling of settings with User Rights should be incorporated with Password protection in the RTU. Each User shall have his/her own User Id & Passwords.

b. User Credentials to access RTU shall be authenticated through Purchaser's Active directory Server.

c. All actions/modifications/deletions shall be logged in the RTU. These logs shall be pushed to Purchaser's Central Asset Management system/SOC.

d. It shall be possible to access the RTU through a web browser (Https Support) anywhere from the LAN for configuration, diagnosis, monitoring, file upload & download, simulation and log retrieval by using appropriate user account management viz. Role based access control & password complexity

e. The RTU should also supports Authentication and Authorization of individual users, Security logging.

f. RTU shall be NERC-CIP/NIST 7628, IEC62351 and IEEE 1686 compliant.

g. RTU shall be enabled with System hardening viz. disabling/removal of unused ports and services.

51) **Test Function**

a. Vendor to provide the detailed test procedure for testing the RTU functionalities using IEC61850, GOOSE messaging and protection scheme Implemented/proposed. Vendor to ensure the required hardware and software to test the above at the time of FAT and SAT.

b. The protection system shall support a test mode where it shall be possible to set or reset binary Input signals, signalling and tripping contacts individually or in groups.

c. All output relay contacts can be blocked via a setting & configuration program.

d. Using the test function, it shall be possible to set or reset signalling & tripping contacts individually.

e. A test sequencer for the local bay protection functions shall be part of the user Interface programme. Virtual current, voltage and binary signals shall be programmable In a minimum of six different sequences to verify the correct operation of the respective functions and settings in the respective bay unit.

f. It shall be possible to run these test sequences and simulations during normal operation, i.e. without affecting the station protection system in service. Re-use of saved test sequences shall be supported.

52) **Binary inputs / outputs:** ***Refer the Indicative BOM***

8.2 **Layer 2 Industrial Grade Managed Switch**

The switch shall be of industrial grade type designed for continuous operation.

a. Switch shall have combination of RJ45 / Fiber ports of 100/1000 Mbps with 20% spare ports of each type.

b. Switch shall be 19-inch rack mountable.

c. Switch shall support IEEE802 series for VLAN, RSTP, MSTP and Suitable for ring configuration etc.

d. Switch shall be IEC 61850 EMC and operating conditions for Power Substations Complaints.

e. Switch shall be IEEE 1613 Environmental Standard for Electric Power Substations complaint.

f. Switch shall have design for minimum Heat generation and high MTBF (minimum time between failure)

g. Switch shall Support Simple plug and play operation - automatic learning, negotiation, and crossover detection

h. Switch shall Support Quality of Service (802.1p) for real-time traffic

i. Switch shall Support SNTP time synchronization (client and server) & IEEE 1588 PTP V2 (Precision Time Protocol) for precise time synchronization of networks

j. Switch shall Support Industrial automation features (e.g. Modbus, Ethernet/IP and PROFINET protocols for transparent data transmission)

k. Switch shall be suitable for PRP/HSR configuration and devices.

l. Switch shall Support Management Tools like:

m. Web-based, Telnet & Command Line Interface (CLI) for quickly configuring major managed functions

n. SNMPv1/v2c/v3 for different levels of network management

i. Remote Monitoring (RMON)

ii. Rich set of diagnostics with logging and alarms

o. **LAYER 2 features**

i. The Switch should support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.

ii. The Switch should support Rapid Spanning Tree Protocol & Multiple Spanning Tree Protocol.

iii. The Switch shall have IEEE compliance for 802.1Q VLAN, 801.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol.

iv. The switch should have support for Port mirroring

v. The Switch should be able to discover the neighbouring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems or equivalent

vi. The Switch should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes

p. **Management features**

i. The Switch should support SNMP v2c, V3

ii. The Switch should support Configurable SNMP traps

iii. The Switch should support Logging to syslog with time stamp

iv. The Switch should support NTP support.

v. Full environmental monitoring of PSUs, fans, temperature and internal voltages, with SNMP traps to alert network managers in case of any failure

q. **Power supply**

i. Switch shall Support Redundant Power supply of 48V/ 110V / 220V DC.

ii. Power supply voltage level shall be selected during detailed engineering

r. **Environmental**

i. The switches should have IEEE 802.3az Energy efficient Ethernet and ROHS compliance

ii. Switch should be capable of operating under normal room temperature without the requirement of Air conditioning.

8.3 **Networking Accessories**

a. **Ruggedized Fiber Patch cords for SAS**

Multimode patch cords of suitable length shall be supplied which would be compatible to the end devices and LIUs. The FO patch cords shall be ruggedized and the patch cord color shall be Orange.

b. **LIUs- SAS**

LIUs which are part of the SAS shall be rack mounted type and shall be installed in network switch panels (L2 switches) as per the configuration diagram. The LIUs type for SAS shall be Multi-mode and the connectors type shall be of ST/LC type(preferably). LIUs shall include all the accessories for terminating the cable such as pigtail, splice holder, coupler etc. All cores of the fiber cable shall be terminated on the LIU. LIU shall be rodent proof.

c. **Patch Panel - SAS**

The Patch panel shall have 24Port with RJ45 Connectors (Jack field) with cable support. All structured UTP armoured cabling shall be terminated through patch panels before connects to Ethernet switch/end equipment.

d. **I/O Box- SAS**

All the structured CAT6 cabling on the device side shall be terminated on I/O boxes. The IO box shall have QUAD face plate with 4 RJ45 connectors, Back covers and mounting screws.

e. **UTP Patch cords (CAT6) - SAS**

Prefabricated (factory crimped) CAT6 UTP Patch cords for intra panel connection/within panel from equipment to equipment.

8.4 **Panel and other Accessories**

a. All Automation Panels shall be front Swing / front fixed type and rear side shall be double door. All the panels shall be of IP54 class and industrial grade.

b. Bidder shall submit the GA drawing considering the clearance between the equipment, easy access and removal during failure/repair, maintenance and aesthetic requirements and submit the drawings along with bill of material for purchaser's review.

c. Panel shall have Louvers (min.2nos) & Fan (Min.2nos) arrangement for ventilation. Bidder shall guarantee the satisfactory functioning of the system hardware mounted in the panels even in the event of failure of air-conditioning.

d. Proper size Cable trough (Width, length) shall be provided in the panel after reviewing the number of cables to be terminated in the panel.

e. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trough.

f. Control panel shall be suitable for bottom cable entry.

g. Interconnection between panels shall be by prefabricated cables with proper conduit.

h. All Source terminal blocks shall be droppable (or equivalent) and the terminals shall be distributed functionally in the panel.

i. Panel door locks shall have the common key.

j. Acrylic glass sheet shall be provided, wherever the power cables & terminations are exposed and prone to be fatal.

k. Electrostatic strap shall be fitted with each panel.

l. **Sheet Metal Work**

The panel frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.5 mm.

Frames shall be enclosed by cold rolled sheet steel of thickness not less than 2 mm, smoothly finished, levelled and free from flaws. Stiffeners shall be provided wherever necessary. The Panels shall be provided with MS Base Channel of 75 x 50 mm

All panel edges and door edges shall be reinforced against distortion by rolling, bidding or by the addition of welded reinforcement member.

Cut-Outs shall be true in shape and devoid of sharp edges.

The complete structure shall be rigid, self- supporting, free from vibration, twists and bends.

m. Constructional Features

SAS cabinet shall be indoor type, floor mounted, with total dimension (2315 (H) x 800 (W) x 800 (D)) and front swing frame or front fixed and rear double door . Front glass door with 19" rack arrangement.

The panel dimension shall be 2200 (H)x800(W)x800mm(D),100 mm(H) plinth and Anti-vibration pad of 15 mm (H) thickness should be provided.

The panel shall be -

i. Of the metal enclosed indoor, floor mounted.
   - Preferred make of Automation Panels – Rittal make only.

ii. Made up of the requisite vertical sections.

iii. dust, moisture and vermin proof construction

iv. It shall have lifting i-bolts for hooks of good capacity and even distributed lifting. Test certificates shall be available for the lifting bolts.

v. Suitable to provide a degree of protection of not less than IP 54 as per IS: 2147.

vi. It is the responsibility of the bidder to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the SAS design shall be properly accommodated in the panel, in such a way that the maintenance, identification, isolation of any component or circuit shall be easy. Equipment shall be mounted such that removal and replacement can be carried out individually without affecting the services of the adjacent devices. No price increase at a later date on this account shall be allowed.

vii. Of self-cooled design with adequate louvers on sides. The louvers shall have screens and filters on inner side of panel. The screens shall be of fine wire mesh made of brass or GI wire.

viii. Provided with labels on the front and rear indicating the panel designation.

ix. Proper provision has to be provided for the entry of FO cables and Ethernet cables at the bottom. AC & DC incoming cable entry provision should also be there.

x. Provided with pocket on rear door for keeping A4 size copy of panel drawings.

xi. Provided with 4 nos. of lifting hooks.

xii. Provided with neoprene gaskets all-round the perimeter of covers, gland plates, removable covers and doors.

xiii. 150 sq.mm copper earth bar has to be provided for equipment earthing.

xiv. All sheet steel work shall be degreased, pickled, phosphated and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside. The paint shade shall be Siemens Grey (RAL 7032/RAL7035). The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns.

xv. For every distribution of AC and DC circuits MCB's has to be provided. These MCB's has to be rated according to the load on the distributed circuit.

xvi. Each RTU/Gateway, Switch panels shall be provided with 20% spare terminals.

xvii. If I/O interface boards are used for field input connection proper isolation facility shall be provided. Preferably disconnecting type of terminal blocks shall be used for all inputs.

xviii. Interconnection between panels shall be by prefabricated cables.

xix. Terminal blocks shall be having provision for isolation, with full-depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Required number of TBs shall be provided for common shield termination for each cable.

xx. All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made up of flame retardant material and shall not produce toxic gasses under fire conditions

xxi. Proper lighting arrangement shall be made on both sides of the panel if both sides of the panels are used.

xxii. Space heater with thermostat shall be provided in the panel to maintain the required temperature & are to be placed at such location so as to not interfere with the field cabling thereby avoiding heating of the field cables at entry point.

xxiii. Disconnecting type terminal blocks shall be used for AC & DC sources and for all Digital Outputs from relay coil for SCADA command.

xxiv. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trough.

xxv. Terminals shall be distributed functionally in the panel.

xxvi. The panel shall also have a document pocket.

xxvii. Horizontal and vertical Grounding bus shall be provided in the panel. Green colored wires shall be used for grounding purpose. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the Panel/Station through a flexible braided copper conductor rigidly.

n. Cabinet Internal Wiring

SAS cabinet shall be wired with all the DC distribution wiring and AC wiring for the Illumination and fans. Following sizes of wires shall be

Colour Codes

DC wiring	**1.5 sq.mm**	**Red/ Black/Grey**
AC wiring	**1.5 sq.mm**	**Blue/Yellow**

Earthing	**2-2.5 sq.mm**	**Green**

Engraved identification ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. These ferrules shall fit tightly on the wires and should not fall off when the wire is removed. The wires should be terminated on terminal blocks using soldering crimping type of tinned copper lugs. Insulated sleeves shall be neatly punched and cleaned without affecting access to equipment mounted within the cabinet. Wiring troughs shall be provided for cable routing inside the cabinet. One piece moulded, 650 V grade terminal blocks complete with insulated barriers, screws, identification strips shall be used. Terminals links shall be of Elmex or Connect well make. Terminals for power connections shall be adequately rated for the circuit current and the rating of other terminal blocks for central indication etc. shall not be less than 15 amps. At least twenty percent spare terminal blocks shall be provided. All the terminal blocks should be provided with proper identification strips. Terminal blocks shall be provided with transparent acrylic covers.

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Cable ways & troughs shall be used for this purpose.

Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.

o. Labels

All equipment’s shall be provided with individual labels with equipment designation engraved. Also the control cabinet shall be provided on the front with a label engraved with designation of the cabinet as furnished by PURCHASER. Labels shall be made up of non-rusting metal or 3 ply lamicoid. Labels shall have white letters on black or dark blue background. Sizes of labels and lettering are subject to PURCHASER's approval.

Manufacturer’s label should be provided at the rear door, which should mention the project ref, substation, P.O ref, circuit details, drawing ref.

p. Earthing Terminals

Control cabinet shall be provided with two separate earthing terminals suitable to receive PURCHASER's earthing conductors of size specified.

Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wire/bars bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All equipment shall be connected to the earth busbar using 1100/650V grade PVC insulated 2.5 sq.mm stranded tinned copper earthing conductor.

All hinged doors shall be positively connected to the earthing bus terminals, with the help of braided copper conductors of adequate size.

An electrostatic discharge arrangement shall be provided in each panel so as to discharge human body before he handles the equipment inside the panels.

DATA SHEETS – SUB-STATION AUTOMATION

Refer annexure E2- 3B Automation Technical Requirement of Automation

- Pre-wired RTU Panel
- Layer-2 Switch
- Networking Accessories (Refer the Technical specification)

9.0 QUALITY REQUIREMENTS, INSPECTION, TESTING

9.1 Quality Assurance

To ensure that a well-engineered and contractually compliant system is produced, vendor shall adhere to a quality assurance program for the preparation of all contract deliverables, which includes hardware, software and documentation. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies. Bidder shall submit the following information along with the Technical Bid and project specific document after award of contract. Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

9.2 Factory Acceptance Test (FAT)

The Vendor shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the Substation Automation System for approval. For the individual bay level, and Misc cum Protection level BCUs applicable type test certificates shall be submitted. The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT).The purpose is to ensure that the Vendor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. During FAT the entire System including complete control and protection system to be supplied under present scope shall be tested for complete functionality and configuration in factory itself. The extensive testing shall be carried out during FAT. The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. No major configuration setting of system is envisaged at site.

9.3 Integrated Testing

The integrated system tests include Protection & Automation shall be performed as detailed in subsequent clauses as per following configuration:

Bay BCU / BCPU's, Gateway, Protection cum Miscellaneous RTU, Station HMI, DR work station, two switches along with all IEDs for the GPS Receiver and clock. Vendor should arrange complete Hardware & software as per the approved architecture under this RFP for the integrated FAT.

All other components for complete sub-station as detailed in section project shall be simulated as needed.

9.4 Hardware Integration Tests

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

9.5 **Integrated System Tests**

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently, and all equipment shall operate properly. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

If the complete system consists of parts from various suppliers or some parts are already installed at site, the FAT shall be limited to sub-system tests. In such a case, the Vendor can use their SCADA System for testing the functionality as per the Users requirement. Otherwise the complete system test shall be performed on site together with the site acceptance test (SAT).

i. Prior to release for shipment of the equipment the Purchaser or his representative shall witness Factory Acceptance Test (FAT) in which the system is checked against the specifications.

ii. The FAT shall include testing of all the hardware and software modules.

iii. Spare modules and spare channels also shall be tested in FAT.

iv. Bidder shall indicate all the simulation facilities that shall be used in FAT.

v. Vendor shall submit FAT procedure 2 weeks before commencement of FAT for purchaser's approval.

vi. Vendor shall incorporate all FAT comments prior to despatch. After Vendor confirms that all changes have been incorporated, Purchaser's Office shall issue Despatch Clearance.

vii. The Test Reports as well as Test Certificates of OEM, third party, Vendor shall be submitted for approval / verification.

viii. Tests shall include demonstration of System Responses and Loading (CPU, Memory & Communication Bus) including worst-case scenario and expandability of the system.

ix. FAT and Despatch Clearance by the Purchaser shall not relieve the Vendor from complete responsibility for the total system and its performance subsequently.

x. Redundancy, Backup & Restoration functions shall be tested.

xi. Diagnostic tools shall be demonstrated.

xii. The system shall be kept ON continuously without interruptions for at least 72 hours during the FAT.

xiii. Tests requiring advanced Laboratory facilities that may not be available at site shall be conducted during FAT.

xiv. Travel, Boarding & Lodging expenses for the Purchaser's representatives for FAT shall be borne by the Purchaser, Local transport for Purchaser's representatives from the place of stay to Vendor's works shall be arranged by the vendor. Vendor shall make available all necessary documentation & office facilities for Purchaser's representatives. Specialists of sub-vendors shall

be present for FAT. Training at Vendor's Works shall precede FAT and shall include troubleshooting and advanced testing techniques.

xv. Deficiency Reporting

- In case of failures, deficiency reports shall be written for hardware, software, functional performance & documentation deficiencies. The deficiency reporting procedure includes methods to ensure that deficiencies are identified, documented & corrected. The documentation shall include a unique identifier for tracking as well as a detailed description of the deficiency. A deficiency status summary shall be included from time to time in the project progress reports, & up to date deficiency reports shall be made available to the purchaser on demand.
- When a test fails, a separate deficiency report shall be written for each problem that prevented the successful completion of the test. Deficiencies shall be classified by their severity as follows:

i. Fatal - Priority A
ii. Major - Priority B
iii. Minor - Priority C
iv. Documentation - Priority D

- The presence of fatal discrepancies, such as the complete failure of the system, shall be acted upon immediately and may, at the discretion of the purchaser, be cause for suspension of the tests. A retest shall be agreed which may include all or part of the test procedures. All other discrepancies shall be corrected and re-tested without suspending the entire test. The purchaser shall have the right to request that other hardware and software modules that may be impacted by the correction be re-tested.

9.6 **Commissioning**

i. The commissioning of the system (hardware and software) including Site Acceptance Test and one month Trouble-free Operation shall be the responsibility of vendor. Development and customization of all software components shall be in Bidder's scope.

ii. Adequate number of competent engineers (Hardware & Software) as approved by Purchaser shall be posted at site during the entire period of installation & commissioning. In addition telecom specialists shall be deputed to site for establishing communication systems.

iii. Daily site work shall be planned and executed as per due approvals from Purchaser's representative.

iv. Vendor shall submit detailed site organization chart of Personnel for Purchaser's approval. Purchaser reserves the right to review the same. Vendor's commissioning engineers shall also train purchaser's engineers during commissioning apart from scheduled Training.

v. The responsibility for Installation, Commissioning, Performance Guarantee and Warranty shall remain with the vendor.

vi. The vendor shall furnish procedures, protocols and time schedules for commissioning and Acceptance Test activities.

vii. All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of bidder.

viii. All passwords, access keys etc. are the property of the Purchaser and shall be handed over to the Purchaser.

ix. All Inter-Operability Tables for interfacing to other systems shall be supplied.

x. Principal's representatives including specialists shall participate at site for supervision & certification of commissioning and Acceptance Tests.

9.7 **Site Acceptance Test (SAT)**

i. SAT shall cover all equipment and functions as specified for the complete system (all hardware & software) and connectivity with Purchaser's system. As such SAT shall cover all the tests listed in FAT along with site-specific tests including interconnections with field equipment and other systems. Apart from testing and commissioning, SAT shall include one month of continuous trouble-free operation of the complete system without major intervention. In case of interruptions, one month trial shall be restarted after attending to the problem.

ii. IEDs used for protection, control, etc.; the redundant inter-bay bus (and associated communications hardware/software), the redundant station bus (and associated communications hardware/software), the time synchronization system (redundant GPS receivers) and the local/station HMI are to be considered as SAS components, and shall undergo commissioning requirements as part of the SAT.

iii. Vendor shall furnish, advance SAT protocols and list of vendor's instruments for site testing. Tests shall include demonstration of loading & expandability of the system.

iv. SAT shall be performed after the system has been installed, the final software has been loaded in each subsystem, all I/Os and functionality checked, system has been running and all commissioning checks have been completed successfully.

v. Unstructured tests shall be employed as necessary, to verify overall system operation under field conditions.

9.8 **Test Procedures**

Test Procedures (for FAT, Commissioning and SAT) shall be prepared by the vendor to test the specified functional and performance requirements of the system which shall include but not be limited to the following:

a. System Hardware Tests

- **Visual Test:**

  Verification that the system includes all required equipment and is properly configured. This includes a visual inspection for proper workmanship and labelling, including cables and connectors.

- Verification of Upgrade and Expansion Capabilities:

  Inspection and verification, to the extent possible, that provision to upgrade and expand the system are furnished as required by the contract.

- **Hardware Diagnostic Test:**

  The hardware diagnostic test consists of individual test of all system hardware. These tests consist of running standard hardware diagnostic programs, plus special diagnostic programs used by vendor where appropriate.

b. System Functional Tests

The purpose of the system functional tests is to rigorously exercise all functions and to verify the correct functional operation of all hardware and software. The system functional tests shall include, but not be limited to, the following tests. The Purchaser shall also be able to perform other tests not specifically mentioned.

- Verification of proper data acquisition & control from the BCUs, RTUs.
- Verification of proper data acquisition from the Energy Meters
- Verification of proper data acquisition & control from Purchaser's external systems.
- Verification of proper data acquisition & control from third party systems.
- Verification of the proper response of the system to include
  - Loss / Restoration of BCUs and RTUs
  - Loss / Restoration of Input Power
  - Loss / Restoration of Communication System
- Verification of System Redundancy including fail-over procedures and restart.
- Verification of all development and maintenance capabilities Including:
- Database Generation and Maintenance
- Back-up and Restoration functions of all systems.

9.9 System Performance Tests

The system performance tests shall verify that the performance requirements are met for the system as specified in the purchaser's technical specification. For example, performance testing shall include the verification of data acquisition performance etc.

9.10 System Availability Test

To ensure that the system software is error-free and that the hardware system is reliable, thirty (30) days continuous run of the system shall be performed after the successful completion of system functional tests and system performance tests. The system configuration shall be as per the final system configuration.

This test shall be considered successful if no critical function is lost and no hardware or software failure occurs within a consecutive 30 days period. Any minor or major hardware deficiencies shall be removed prior to starting the test.

During this test, the system shall be exercised a manner, which approximates an operational environment. No software patches, modifications, or changes shall be allowed to bypass failed modules during this test. If a module affecting a critical function fails. The failed module shall be replaced, and portions of the system functional tests affected by the change shall be repeated and the system availability test shall be re-run in totality.

10.0 PERFORMANCE REQUIREMENTS

10.1 System Performance Standards

The system shall meet performance as per the IEC & IS standards required to maintain real-time monitoring and control of the network.

10.2 System Response

The system shall meet the following response and resource utilization requirements:

a. The system functions and associated databases shall be capable of accommodating at least a 50% increase in the delivered capacity without requiring regeneration, recompilation, or any processing other than definition of the database by Tata Power.

b. All Digital Inputs shall be reported with a resolution of 1 msec.

c. All Digital Inputs shall have individual channel reporting

d. The system shall report correct Time Stamping when all process inputs scanning & processing is in progress & all the data is transmitted over Data Bus every sec.

e. The worst loading condition shall include the following tasks:

- All processor inputs scanning and processing is in progress and all the data is transmitted over the main data bus every sec.
- All controls in operation.

- Control / information request is initiated from all terminals.

10.3 **System Utilization**

Name	Utilization	Comments
Main Memory	30% 50%	Normal Loading Peak Loading
Processor Utilization Application processor Communication processor	 30% 50% 30% 50%	 Normal Loading Peak Loading Normal Loading Peak Loading
Local Area Networks	40% 60%	Normal Loading Peak Loading

11.0 SPARES AND SPECIAL TOOLS AND TACKLES

The spares supplied shall be strictly interchangeable with parts for which they are intended for replacement.

The spares shall be treated and packed for long storage (minimum 5 years) under the climatic conditions prevailing at the site.

The start-up spares shall be delivered at the site well in time before the start-up and commissioning of the plant.

11.1 Start-Up Spares

The start-up spares are those spares which will be required during start-up and commissioning of the equipment/systems, and until Final Take Over. It is the responsibility of the bidder to supply all the necessary spares as required until the equipment/systems are handed over to the Owner. An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, performance testing and handing over the equipment/systems to the Owner will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over the sub-station shall remain the property of the Owner. The Bidder shall furnish the Schedule of Start-up Spares.

11.2 Mandatory Spares

Essential spares are those considered necessary by the owner for first three (5) years of normal sub-station operation. A list of such spares has been listed in the below mentioned table and the same shall be included in bidder's scope. When a particular item of spares is indicated as `percentage', it shall be considered as percentage of total number of that item of spares in the single equipment/system, unless specified otherwise and the fraction shall be rounded-off to the next higher whole number. Whenever the item of spares has been indicated as `set' the same

shall mean the supply for a single equipment/system. One set of spares for the particular equipment shall mean the total quantities of that particular spares for a single equipment e.g., `set' of Server, set of Gateway, shall include HMI, keyboard, mouse etc. The `set' shall however include all components required to replace that item of spares. The Owner reserves the right to buy any of the essential spare parts as considered necessary.

In case during start-up and commissioning certain essential spares are used up, the same shall be replaced within one (1) month without any commercial implications.

Bidder shall furnish details for all essential spares as per the approved vendor document list.

Bidder to consider following mandatory spares in the offer.

SL. No.	System	Qty. (Nos./Set)
1	Managed Layer-2 Switch (Each type)	1 Set.
2	Communication Processor each Type-1no	1 Set
3	DI Cards	2nos
4	DO Cards	2nos
5	Optical Isolation Board (if applicable)	2nos
6	Master Communication Unit (if applicable)	1no
7	Fiber Multi-Mode Patch Cords Duplex (2 metres)	5 nos.
8	Fiber Multi-Mode Patch Cords Duplex (5 metres)	5 nos.
9	CAT6 Patch Cords (2 meters)	5 nos.
10	CAT6 Patch Cords (5 meters)	5 nos.
11	IPC Machine along with OS- Advantech 610H or above	1 Set

Table-3

11.3 **Recommended Spares**

In addition to the spares mentioned above, the Bidder shall also furnish in his bid a list of recommended spares with unit prices. The Owner reserves the right to buy any of the recommended spare parts as considered necessary by him. The prices of recommended spares shall be consistent with those of start-up/essential spares. Purchase of these spare parts will be covered by a separate order or an amendment to the contract.

The Bidder shall provide a list of recommended spares for a period of five years from the date of handover of the project to Owner. The shelf-life of these spares is such as to last for at least 7 years from the date of handover of the project.

The Bidder shall provide the MTBF of various components, sub-assemblies, assemblies etc. (recommended as spares) and the relationship between MTBF and spare quantities recommended.

The Bidder shall submit the product life cycle details of the all hardware offered under this RFP.

The table above indicate the minimum requirement of the owner, bidder to include the spares, which are not part of this table, but required for maintenance and upkeep of the system

11.4 **Special Tools & Tackles**

Bidder to consider and supply special tools and tackles required for erection, commissioning and maintenance of the offered system. After commissioning of the system all tools and tackles shall be handed over to Owner's Project/Maintenance team.

All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of bidder.

All configuration cables and other specialized testing passive devices to be provided with the supply of material.

12.0 DATA SUBMISSION BY BIDDER

Following Documents must be submitted along with the bid.

Bids are liable to be rejected if following minimum documents are not submitted along with the bid.

a. Deviation if any from specification strictly following the prescribed format.

b. Compliance to the approved vendor list

c. List of major relevant experiences of the Principal, Collaborator and the Product respectively.

d. Technical support facilities including qualified man-power, testing tools and instruments and integration facilities available within India.

e. Technical data sheet of critical equipment

f. System architecture drawing.

g. Compliance to data sheets covered in the specification.

h. Product life cycle document for all supplied equipment.

i. Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

j. Type test certificates of the offered equipment

k. Confirmation on lifetime, spares, manufacturing, onsite & Offsite technical support of the supplied equipment for the period of 15 years.

l. The Bidder shall furnish the following drawings/documents during detailed engineering within 2 month from date of PO Placement Bidder to submit all datasheets, detailed GTP of the proposed BOM items during detailed engineering for the approval and finalization by Owner.

m. System Architecture Drawing. This drawing should show in detail of the following:

   i. Network connections

ii. Protocol used

iii. Type of interconnecting cable

iv. All IED's, workstations, gateways, network switches, meters etc. which are part of the SAS.

n. Panel GA and Complete wiring diagram

o. Functional Design Specification document

p. Step by Step test procedures for Factory Acceptance Test (FAT) and Site Acceptance Test (SAT)

q. SCADA I/O List with protocol details along with addresses

r. Interconnection Schedule (ICS) for Automation

s. Hardware, Software and Application manuals for all the equipment supplied including that of Third parties.

t. All Software Licenses (both own & third party), key for Hardware Locks

u. All interoperability tables

v. Guaranteed technical parameters & Guaranteed availability and reliability

w. Calculation for power supply dimensioning

x. Bill of Material listing equipment designation, make, type ratings, etc. of all the equipment's supplied

y. Logic Diagram (Hardware & Software)

z. Operator's Manual

aa. Complete documentation of implemented protocols between various elements

bb. IP addressing chart for all the IED's, Gateways, Workstations, network switches which are connected to the network

cc. Diagnostic and performance evaluation software and hardware tools

dd. Details of software (Operating systems, application software, engineering tools, communication systems management software, license details, I/O distribution protocol-wise etc.) for SAS computer equipment (including PCs, Station HMI equipment and configuration laptop computers) and loadable in CD/DVD ROM

ee. All SAS related drawings in both AutoCAD & Pdf format only. However, the pdf versions of above drawings shall be submitted through wrench for formal approval process. All AutoCAD drawings of the entire project shall be submitted through Secondary Media viz. USB Storage disk.

ff. Bidder shall agree to comply with minimum quality requirements and Contractor Safety Code of Conduct, defined in bid documents.

gg. Other documents as may be required / applicable during detailed engineering

hh. All drawings and data shall be annotated in English.

ii. Bidder shall furnish six (6) hardcopies and 3 soft copies on reliable media of all drawings, manuals (Administration, Operation & Maintenance, Troubleshooting and Installation), Technical catalogues, Test Certificates and Acceptance Test Reports.

jj. Two copies of the internal test report, FAT and SAT documents with test protocol formats shall be submitted for approval at least 4 weeks before Factory Acceptance Test. Two copies of SAT protocol shall be submitted for approval at least two weeks before Site Acceptance Test.

kk. Bidder shall also furnish Original plus one copy of all System Software (OS, Application and tools) along with delivery. Bidder shall submit two copies of all the configuration, application, display, database backup of all equipment on reliable secondary media.

13.0 ANNEXURES

Annexure 1

List of preferred vendor list

Sl. No.	Item Description	Preferred Make / Model
1	Bay Control Unit (BCU) / Remote Terminal Unit (RTU)	ABB/Siemens/GE T&D
2	Gateway	ABB/Siemens/GE T&D
3	Disturbance Record Collector & Analysis System (DRCA)	Make: Kalkitech Model: Sync 3000
3	Layer 2 & Layer 3 Ethernet Switch	Ruggedcom / Hirschman / MOXA
4	Firewall	Juniper/Cisco/Checkpoint/Palo Alto
5	LIU (Fiber Optic)	Raychem / AFS / 3M
6	I/O Boxes	Systimax / Tyco/ CommScope
7	Armored UTP CAT6 Cable	Systimax / Tyco / CommScope
8	Armored Fiber Optic Cable	Finolex / KEC / Apar
9	Unarmored UTP Cable	Systimax / Tyco / CommScope
10	Patch Panel (RJ45) with Connectors, I/O boxes	Systimax / Tyco / CommScope
11	Fiber Optic Patch Chords	Raychem / Preston / Tyco
12	CAT6 UTP Patch Chords	Systimax / Tyco / CommScope
13	4P X 0.36 Sq.mm. Armored Communication Cable (Multistrand, individual pair and overall shielded)	BELDEN / LAPP / SATYAM
14	4P X 0.36 Sq.mm. Unarmoured Communication Cable (Multistrand, individual pair and overall shielded)	BELDEN / LAPP / SATYAM
15	Fiber Optic Transceiver	CTC union / MRO TEK / Allied Telesis / MOXA
16	GPS Clock with remote display unit	Sertel / Masibus / SANDS/Meinberg
17	Gateway / DRCA/RTU/Network Panel (SAS)	Rittal
18	Layer -3 Stack Switch panel (Communication)	Valrack
19	RS 232 / RS 485 converter	MOXA / Advantech
20	DC-DC Converter	Cossel / Phoenix / Paramount
21	Diode-Oring Unit	Paramount / Phoenix
22	Droppable type Terminal Block for Digital	Connectwell – CBT4U or equivalent

	Output, CT & PT.	
23	Disconnecting type (Knife edge) Terminal Block for Digital Input	Connectwell - CKT4U or equivalent
24	Auxiliary Relays – BCU Breaker Isolator & other Digital Inputs	Make – OMRON MM4XP-D MM2XP-D
25	Auxiliary Relays - Miscellaneous RTU	OMRON
26	Multifunction Meter	Make – SATEC Model – PM130EH+
27	Rack Mounted Sliding monitor with keyboard & Touch pad.	Make – ATEN
28	Voltage Transducers	Make – RISHABH
29	Modbus TCP/IP converter	Moxa, Advantech
30	Configuration Laptop	HP/DELL/Lenovo
31	Temperature & Humidity Sensor	Make & Model : KIMO & C-310

ANNEXURE – II

Indicative Bill of Material- Sub-Station Automation

(Bidder shall refer the equipment technical specification for more details and offer the solutions accordingly)

Refer the attached Indicative Automation BOM annexure separately

ANNEXURE III

Reference Input / Output List

The below I/O list is only for reference, the same will be finalized during detailed engineering

Signal Description	SIGNAL TYPE	STATE TABLE	
		STATE 01	STATE 10
LINE			
DIGITAL INPUTS (On Soft)			
DIFF. A-PH START	SPI	START	RESET
DIFF. B-PH START	SPI	START	RESET
DIFF. C-PH START	SPI	START	RESET
LINE DIFF. PROTN OPTD (1PH)	SPI	RESET	OPTD
LINE DIFF. PROTN OPTD (3PH)	SPI	RESET	OPTD
LINE DIFF.87L OUT	SPI	NORMAL	OUT
LINE DIFFERNTIAL COMMUNICATION CHANNEL	IGEN	HEALTHY	FAIL
CARRIER RECEIVE	SPI	RESET	OPTD
CARRIER SEND	SPI	RESET	OPTD
A/R START	SPI	RESET	OPTD
A/R OPTD	IGEN	RESET	OPTD
A/R BLOCK OPTD.	IGEN	RESET	OPTD
A/R IN	DPI	IN	BLOCK
A/R BLOCK SEL	DPI	IN	BLOCK
CARRIER FAIL	SPI	HEALTHY	FAIL
CARRIER OUT	SPI	NORMAL	OUT
DT RECEIVE	SPI	RESET	OPTD
DT SEND	SPI	RESET	OPTD
DIS. A-PH START	SPI	START	RESET
DIS. B-PH START	SPI	START	RESET
DIS. C-PH START	SPI	START	RESET
DIS. RELAY ZONE-1	IGEN	RESET	OPTD
DIS. RELAY ZONE-2	IGEN	RESET	OPTD
DIS. RELAY ZONE-3	IGEN	RESET	OPTD
DIS. RELAY ZONE(AIDED TRIP)	IGEN	RESET	OPTD
DIST. PROTN OPTD (1PH)	SPI	RESET	OPTD
DIST. PROTN OPTD (3PH)	SPI	RESET	OPTD
SOTF PROTN. OPTD.	IGEN	RESET	OPTD
POWER SWING OPTD.	SPI	RESET	OPTD
FUSE FAIL OPTD.	SPI	RESET	OPTD
LBB IN SELECTION	SPI	NORMAL	OUT
LBB INITIATION	SPI	RESET	OPTD
LBB PROTN OPTD.	SPI	RESET	OPTD
MAIN-1 PT MCB HEALTHY	SPI	HEALTHY	FAIL
LINE NO VOLT	SPI	RESET	OPTD
GR-A SETTING	SCO	ACTIVATE	NIL

GR-B SETTING	SCO	ACTIVATE	NIL
GR-C SETTING	SCO	ACTIVATE	NIL
GR-D SETTING	SCO	ACTIVATE	NIL
SPARE			
SPARE			
SPARE			
SPARE			
OLTS IN	SPI	NORMAL	OUT
OLTS ALARM	IGEN	RESET	OPTD
OLTS PROTN OPTD	IGEN	RESET	OPTD
67. A-PH START	SPI	START	RESET
67. B-PH START	SPI	START	RESET
67. C-PH START	SPI	START	RESET
67 PROTN OPTD	IGEN	RESET	OPTD
67N PROTN OPTD	IGEN	RESET	OPTD
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
RELAY FAIL (IRF)			
SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
Hardwired Signals-Digital Inputs			
Note : ** Signals duplicated on Soft as well as Hardwired			
LBB OUT SELECTION **	**SPI**	**NORMAL**	**OUT**
67/67N RELAY UNHEALTHY	SPI	HEALTHY	FAIL
3PH GR-A TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
3PH BUSBAR TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
CB TC1 UNHEALTHY	SPI	HEALTHY	FAIL
3PH GR-A TRIP RELAY OPTD	SPI	RESET	OPTD
3PH BUSBAR TRIP RELAY OPTD	SPI	RESET	OPTD
MAIN-1 CARRIER OUT**	SPI	NORMAL	OUT
MAIN-1 87L PROTN OUT**	SPI	NORMAL	OUT
A/R OUT SELECTION**	SPI	NORMAL	OUT
DC-1 FAIL	SPI	HEALTHY	FAIL
PT MCB FAIL	SPI	HEALTHY	FAIL
DIST PROTN Z1 OPTD	SPI	RESET	OPTD
MAIN-1 DT RECEIVE**	SPI	RESET	OPTD
MAIN-1 DT SEND**	SPI	RESET	OPTD
OLTS OUT SELECTION**	SPI	NORMAL	OUT
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-1 AC MCB FAIL	SPI	HEALTHY	FAIL
3PH GR-B TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
CB TC2 UNHEALTHY	SPI	HEALTHY	FAIL

3PH GR-B TRIP RELAY OPTD	SPI	RESET	OPTD
PTMCB FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL
DIST. PRONT Z1 OPTD	SPI	RESET	OPTD
DC-2 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-2 AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186A RELAY RESET	SCO	NORMAL	RESET
186B RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
LBB IN/OUT SELECTION	DCO	OUT	IN
OLTS IN/OUT SELECTION	DCO	OUT	IN
M1 CARRIER IN/OUT SELECTION	DCO	OUT	IN
M1 87L IN/OUT SELECTION	DCO	OUT	IN
A/R IN/OUT SELECTION	DCO	OUT	IN
Transformer			
Relay-1			
DIGITAL INPUTS (On Soft)			
DIFF. A-PH	SPI	RESET	OPTD
DIFF. B-PH	SPI	RESET	OPTD
DIFF. C-PH	SPI	RESET	OPTD
TRAFO DIFF. 87T PROTN OPTD	SPI	RESET	OPTD
HV O/C. A-PH START	SPI	START	RESET
HV O/C. B-PH START	SPI	START	RESET
HV O/C. C-PH START	SPI	START	RESET
HV O/C DMT PROTN OPTD	SPI	RESET	OPTD
HV O/C IDMT PROTN OPTD	SPI	RESET	OPTD
HV E/F PROTN OPTD	SPI	RESET	OPTD
HV LBB IN SELECTION	SPI	NORMAL	OUT
HV LBB INITIATION	SPI	RESET	OPTD
HV LBB PROTN OPTD.	SPI	RESET	OPTD
HV OVERFLUX PROTN OPTD	SPI	RESET	OPTD
HV OVERLOAD PROTN OPTD	SPI	RESET	OPTD
TRAFO LV STANDBY E/F PROTN OPTD	SPI	RESET	OPTD
MOG (OLTC) ALARM	SPI	RESET	ALARM
MOG (MAIN) ALARM	SPI	RESET	ALARM
BUCH HOLZ ALARM	SPI	RESET	ALARM
PRV-1 (OLTC) TRIP	SPI	RESET	ALARM
PRV-2 (MAIN) TRIP	SPI	RESET	ALARM
BUCH HOLZ TRIP	SPI	RESET	ALARM
OSR TRIP	SPI	RESET	ALARM
RAPID PRESSURE RELAY OPTD	SPI	RESET	ALARM
OTI TRIP	SPI	RESET	ALARM
WTI HV/LV ALARM	SPI	RESET	ALARM
WTI HV/LV TRIP	SPI	RESET	ALARM
OTI ALARM	SPI	RESET	ALARM

A-PH FAULT CURRENT	ANALOG	-	VALUE
B-PH FAULT CURRENT	ANALOG	-	VALUE
C-PH FAULT CURRENT	ANALOG	-	VALUE
87 BLOCK	IGEN	HEALTHY	FAIL
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
MAIN-II RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
M1- SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
M1- SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
LV OLTS OUT SEL.	SPI	NORMAL	OUT
LV OLTS ALARM	IGEN	RESET	OPTD
LV OLTS PROTN OPTD	IGEN	RESET	OPTD
RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Inputs			
Note : ** Signals duplicated on Soft as well as Hardwired			
HV LBB OUT SELECTION**	SPI	NORMAL	OUT
MAIN-1 RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-A TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
LV-1 3PH TRIP RLAY UNHEALTHY	SPI	HEALTHY	FAIL
LV-2 3PH TRIP RLAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH BUSBAR TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV CB TC1 UNHEALTHY	SPI	HEALTHY	FAIL
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
HV 3PH GR-A TRIP RELAY OPTD	SPI	RESET	OPTD
LV-1 3PH TRIP RELAY OPTD	SPI	RESET	OPTD
LV-2 3PH TRIP RELAY OPTD	SPI	RESET	OPTD
HV 3PH BUSBAR TRIP RELAY OPTD	SPI	RESET	OPTD
MOG(OLTC) ALARM**	SPI	RESET	ALARM
MOG (MAIN) ALARM**	SPI	RESET	ALARM
BUCH HOLZ ALARM**	SPI	RESET	ALARM
PRV-1(OLTC)TRIP**	SPI	RESET	ALARM
RAPID PRESSURE RELAY OPTD**	SPI	RESET	ALARM
OTI TRIP**	SPI	RESET	ALARM
WTI HV/LV ALARM**	SPI	RESET	ALARM
MAIN-1 PT MCB UNHEALTHY	SPI	HEALTHY	FAIL
DC-1 FAIL	SPI	HEALTHY	FAIL
PANEL-1 AC MCB FAIL	SPI	HEALTHY	FAIL
MAIN-2 RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-B TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV CB TC2 UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-B TRIP RELAY OPTD	SPI	RESET	OPTD
PRV-2 (MAIN) TRIP**	SPI	RESET	ALARM
BUCH HOLZ TRIP**	SPI	RESET	ALARM
OSR TRIP**	SPI	RESET	ALARM
WTI LV/HV TRIP**	SPI	RESET	ALARM
OTI ALARM**	SPI	RESET	ALARM

MAIN-2 PT MCB FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL
DC-2 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-2 AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186A RELAY RESET	SCO	NORMAL	RESET
186B RELAY RESET	SCO	NORMAL	RESET
LV1 86 RELAY RESET	SCO	NORMAL	RESET
LV2 86 RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
LBB IN/OUT SELECTION	DCO	OUT	IN
OLTS IN/OUT SELECTION	DCO	OUT	IN
110KV BUSCOUPLER			
DIGITAL INPUTS (On Soft)			
O/C. A-PH START	SPI	START	RESET
O/C. B-PH START	SPI	START	RESET
O/C. C-PH START	SPI	START	RESET
O/C STAGE-1 PROTN OPTD	SPI	RESET	OPTD
O/C STAGE-2 PROTN OPTD	SPI	RESET	OPTD
E/F STAGE-1 PROTN OPTD	SPI	RESET	OPTD
E/F STAGE-2 PROTN OPTD	SPI	RESET	OPTD
LBB PROTN OPTD.	SPI	RESET	OPTD
3PH LBB INITIATION	SPI	RESET	OPTD
LBB IN SEL.	SPI	NORMAL	OUT
SYNCH ON/BYPASS	SPI	NORMAL	IN
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
M2- SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
M2- SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
Hardwired Signals-Digital Inputs			
Note: ** Signals duplicated on Soft as well as Hardwired			
BUS-1 PT MCB 1 FAIL	SPI	HEALTHY	FAIL
BUS-2 PT MCB 2 FAIL	SPI	HEALTHY	FAIL
NUMERICAL RELAY PT MCB 3 FAIL	SPI	HEALTHY	FAIL
NUMERICAL RELAY SYNCH PT MCB 4 FAIL	SPI	HEALTHY	FAIL
PT-1 SELECTED	SPI	NORMAL	SELECTED
PT-2 SELECTED	SPI	NORMAL	SELECTED
PT INDEPENDENT SELECTED	SPI	NORMAL	SELECTED
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
DC-1 FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL

DC-2 MCB FAIL	SPI	HEALTHY	FAIL
3PH 86 TRIP RELAY FAIL	SPI	HEALTHY	FAIL
3PH BB TRIP RELAY FAIL	SPI	HEALTHY	FAIL
3PH 86 TRIP RELAY OPTD	SPI	RESET	OPTD
3PH BB TRIP RELAY OPTD	SPI	RESET	OPTD
TC-1 UNHEALTHY	SPI	HEALTHY	FAIL
TC-2 UNHEALTHY	SPI	HEALTHY	FAIL
50/51 RELAY FAIL	SPI	HEALTHY	FAIL
LBB IN SELECTION**	SPI	NORMAL	IN
SYNCH IN SELECTION**	SPI	NORMAL	SELECTED
AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186 RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
BUS1 PT SELECTION	SCO	NORMAL	SELECTED
BUS2 PT SELECTION	SCO	NORMAL	SELECTED
IND. PT SELECTION	SCO	NORMAL	SELECTED
SYNCH IN/OUT SELECTION	DCO	IN	OUT
LBB IN/OUT SELECTION	DCO	IN	OUT

Note: The above IO list is indicative. However, the final IO list will be reviewed and finalized during detailed engineering, as per the design requirement (Conventional & Process bus based digital Substation Bays)

All Lockout relay reset ,IN/OUT commands from SCADA will be on soft through IEC61850 as per specification.

.

Annexure – IV

Standard Quality Plan

Attached Separately

END

SECTION B

CHAPTER - B2.3E

TECHNICAL SPECIFICATION

FOR

“Sub-station Automation System and Digital Substation for PAC System”

Rev. No	Date	Revision History	Prepared By	Checked By	Approved By
R0	22-03-2021	Final release	VS	RSM	BSP B S Pisolkar

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1.0 INTRODUCTION

Tata Power Company Limited (Tata Power) hereinafter called the "OWNER" or "PURCHASER", proposes to refurbish the existing Protection, Automation & Communication in its existing 110kV Receiving Station to improve reliability and to cater to the need of Mumbai consumers.

The document covers design, engineering, manufacture, fabrication, integrated testing at manufacturers works, delivery, unloading at site, storage, erection, testing and commissioning at site of the Substation Automation System for the 110kV system and Process Bus based digital substation with Control, Protection and Substation Automation System (SAS) for Typical Bays (1no. line bay & 1no.Transformer) at 110kV Kolshet substation, as required.

a. New Substation Automation System at 110kV Kolshet Station

b. Complete Process Bus based digital substation for Transfer Breaker bay, Transformer – 3 & Transformer - 4 Bays and Seamless integration with existing Gateway System.

It is the intent of this specification to describe primary features, materials, and design & performance requirements and to establish minimum standards for the work. The specification is not intended to specify the complete details of various practices of manufactures/ bidders, but to specify the requirements with regards to performance, durability and satisfactory operation under the specified site conditions.

Bidder shall refer the entire project specifications to understand the execution methodology and interface equipment specification for the complete Scope of work of this project. Bidder shall offer the SAS Supply &Services accordingly.

All equipment, system and services covered under this specification shall comply with all current applicable statutory regulations and safety codes in the locality where the equipment is proposed to be installed. The equipment and systems shall also conform to the latest version of applicable codes and standards on the date of offer made by the Bidder, unless otherwise indicated. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

The offered digital substation bays shall meet all the performance parameters which has envisaged under conventional AIS without Process Bus. Bidders are encouraged to consider the BOQ accordingly.

2.0 BIDDER'S QUALIFICATION REQUIREMENTS & APPROVED VENDOR LIST

2.1 Approved Vendor List for Tata Power

Following Automation System Manufacturers are approved for supply and installation of Sub-Station Automation System.

a. M/s Siemens India Limited

b. M/s ABB India Limited

c. M/s GE (T&D) India Limited

Tata Power's preferred list of vendor / sub vendor / OEM (Refer Annexure-I List of Preferred Equipment's), which is shared as part of Technical Specifications and the same should be adhered by the bidder

2.2 **Bidder's Qualifying Requirement**

Bidder must meet all following qualifying criteria for Substation Automation Systems:

a. The bidder should have supplied minimum 20 nos. Protection, Automation and Communication systems for 110 kV and above sub-stations with at least 10,000 Input-Output Points (of Gateways) for each project. The system supplied should have been in satisfactory commercial operation for a minimum period of 05 years as on scheduled date of the bid opening. Bidder shall offer latest software on open architecture and should have supplied these at least for 5 projects in last 2 years. Protection and Sub-Station Automation must be from the same OEMs.

b. Indian Subsidiaries of global companies having plant in India are also eligible to bid if the qualification requirements stated above are met independently or in combination with the parent company. Declaration from parent company needs to be submitted.

c. Bidder must be OEM of protection relays, Sub-station Automation and Communication system, having manufacturing and testing facility in India.

d. The bidder shall submit Type test reports obtained from NABL/ International Accredited Lab for the equipment / material offered. The type tests should have been conducted on the equipment / material of the same design. The type tests should have been conducted within 5 years prior to the date of bid opening. Time period for type test may be extended by another 5 years as a special case, if there is no change in design / material of construction (MOC).

e. In case the type test reports furnished are not for the quoted equipment / material , but for the equipment / material with higher voltage class and/or different capacity, then type test shall be carried out for the offered equipment / material from NABL / International Accredited Lab without any cost implication to the owner and the Type Test reports shall be submitted before despatch of the equipment / material.

f. EPC Experience (if applicable), In case the package involves installation & commissioning of the equipment / material, then the bidder shall have the following experience:

a) He should have successfully completed one single order of value XXX INR (80% of estimated value of similar work in last three years) OR

b) He should have successfully completed two single orders of value XXX INR(50% of estimated value of similar work in last three years) OR

c) He should have successfully completed three single orders of value XXX INR (40% of estimated value of similar work in last three years).

3.0 SYSTEM DESCRIPTION AND SCOPE

The scope of work shall include but not be limited to the following:

3.1 The BIDDER shall consider scope for design, engineering, manufacture, procure, inspect/test at manufacturers works; deliver to the site, do erection, installation and testing, commission and hand over of a complete system which includes Process bus based Digital Substation Automation System (SAS) based on IEC61850 standards along with all its components and auxiliaries as described in sections below, integrations with other existing / third party systems etc. including integration of BCUs, Protection IEDs, condition monitoring devices, Gateway to Purchaser's SCADA Systems etc.

The scope of supply of SAS includes, in minimum, the following:

a. Switchgear Control Units (SCU).

b. MUs (As per Protection Specification)

c. Bay Control Units

d. Redundant GPS receiver for both Process bus & Station Bus

e. Ethernet Switches for Process Bus & Station Bus

f. Multifunction meters

g. Miscellaneous RTU

h. Networking accessories viz. Networking panel for SAS, 4 Port I/O boxes with Quad face plates, RJ45 connectors, Patch panels, FO & CAT6 patch chords, FO & CAT6 armoured & unarmoured cables, LIUs, RS485 armoured & unarmoured communication cables etc. for the complete Process based Digital Substation.

i. System management Software’s and tools

j. Other components and accessories, hardware, software and firmware, to interconnect and integrate the above items into a common fully functional system.

k. Mandatory Spares

3.2 The offered SAS system/solution shall be from single OEM and the entire automation products shall be from the same OEM family/ same SAS product series. Bidder cannot offer multiple product from Same OEM/multiple vendor to meet the design requirement.

3.3 Bidder shall consider Switchgear Control Unit (SCU) per bay with the Minimum configuration of 64BI/20BOs. The SCU shall acquire all Bay related signals viz Equipment

Status & Control of the Bay, all Bay related alarms, Condition monitoring of the Bay etc., Bidder shall refer the I/O list for the same.

3.4 The SCU shall be non-redundant and shall be mounted in a Separate panel (***shall be referred herein after as Process Bus Panel in this specification***) along with Merging Units.

3.5 The proposed BCUs shall be same family of Protection relay and shall be mounted in the Protection relay Panel along with Protection Relays of the respective bay.

3.6 The BCUs shall be non-redundant and shall be considered per bay.

3.7 All Process Bus (SCU, BCU, MUs) & Station Bus equipment (BCU, Protection Relay, GPS) shall have redundant power supply. The Power supply of these equipment will be Station DC voltage i.e., 110v/220v DC.

3.8 Bidder shall consider Mounting kit, suitable communication viz. Cables, LIUs/IO boxes etc., with accessories and structure communication from each bay to Networking panel.

3.9 Each 110kV bay will have Multi-function meter (MFM) and shall be mounted in the respective Process Bus Panel. Bidder to consider a separate MFM for all Bus PTs other than the MFM on the Bus coupler bay. All MFMs will be integrated to Gateway on Modbus-RTU protocol

3.10 Bidder shall consider independent MCB isolation for each equipment mounted in the panel (all Prewired Panels).

3.11 A separate Network panel shall be considered for mounting the ethernet switches and networking accessories for the integration of Process Bus equipment viz. MUs, SCUs etc., with Station Bus. The Network panel with Swing frame front opening & no rear access and the dimension shall be 2200(H)x800(W)x800(D)mm and proposed to be installed in the same row (nearer) of the Process Bus Panel.

3.12 The process bus based digital substation shall be on Fibre Optic Communication

3.13 The Communication network for Process Bus and Station bus shall be independent. Bidder shall consider Switches and communication accessories accordingly. The Process Bus Communication network shall be on PRP and the Station bus network shall be non-PRP on IEC68150 for integration with Proposed Automation system along with other 110kV Bays (Conventional bays).

3.14 All Communication Equipment viz. Ethernet Switches, Converters etc., shall have redundant Power supply and shall be on Station DC (48v DC/110v DC/220V DC).

3.15 Bidder shall consider the redundancy of Communication accessories (Both active & passive) in all the aspects viz. equipment level, Media/path, Power supply etc., Example. Bidder to consider redundant LIU in each Process Bus Panel for communication to Network

panel. Same shall be followed for the further communication to Station Bus and Integration with SCADA

3.16 It is bidder responsibility to estimate the bandwidth requirement considering the worst-case scenario and design the solution. All the integrated equipment such as Ethernet switches, termination boxes, converters etc., shall be considered accordingly.

3.17 The Protection IEDs shall be on Fiber Optic based communication and shall be integrated to the Gateway on IEC61850 protocol (Refer the Protection specification for more details)

3.18 The Proposed Main -1 & Main-2 Relay communication Network shall be independent to enhance reliability & redundancy. Bidder shall consider Ethernet switches, Cables, Termination boxes, Patch cords and other networking accessories accordingly in their scope. Bidder shall consider the communication equipment either in the protection panel or in a separate network Panel (2200x800x800mm). The same shall be finalized during detailed engineering.

3.19 All Process bus & Station Bus equipment shall have Electronic earthing to the nearest grounding box/earth pit. Any special earthing requirements (in case) for both process & Station bus equipment, Bidder should clear recommend/propose in the bid along with details.

3.20 A separate Redundant Gateway Panel shall be considered for integration of BCUs, Protection IEDs, Misc. RTU, Condition monitoring devices, and various Auxiliary Systems. Further, the Gateway shall communicate to Purchaser's SCADA Systems on IEC60870-5-104 protocol. The proposed Gateway shall communicate simultaneously with Four Independent Redundant Purchaser's SCADA systems.

3.21 Bidder shall consider Redundant GPS receiver along with Surge Protection unit for the both Process Bus and Station Bus time synchronization. These units shall comply to latest IEEE1588 and SNTP standard protocol respectively.

3.22 The GPS receiver shall be mounted in Gateway Panel. Bidder shall consider accessories viz. Cables, Mounting kit, Redundant Antenna etc., in the scope.

3.23 The Gateways shall also get integrated with other existing station auxiliary systems viz. Battery charger, Fire protection & detection system, UPS, DG set, Condition monitoring system of the equipment such as Temperature & Humidity units, 415V switchgears, ACDB, DCDB, Battery- battery chargers etc., on open Protocols. However, Critical alarms from these systems shall be hardwired to Misc. RTU.

3.24 Other Protection function such as Carrier IN/OUT, Diff IN/OUT, LBB IN/OUT, A/R IN/OUT, OLTS IN/OUT,86 OPERATED/RESET etc., shall be on soft and shall be integrated on IEC61850 protocol with Gateway along with other protection functions. Bidder shall refer the *Section-B-3A of Digital Substation Protection Specification* for more details.

3.25 Supply, Installation and Commissioning of DRCA system along with Firewall for Automatic DR & relay Parameterization from local & Remote. The Supplied DRCA shall be integrated with multi-vendor IEDs supports interoperability viz. ABB, Siemens, GE etc on IEC61850 Protocol and also with existing IEDs at Purchaser's site.

3.26 Integration of proposed protection IEDs with new Disturbance Record Collector Cum Analyzer (DRCA) systems as well as Purchaser's centralized DR system. The technical scope includes Auto DR, Relay parameterization, configuration, fault record collection & analysis from local & Remote location.

3.27 Bidder shall consider the Integration of existing 22kV & 33kV BCPUs with New Proposed DRCA system.

3.28 Bidder shall consider Redbox, Converters etc., in case of integration of any Single attached Node (SAN) equipment integration to Gateway & DRCA system as per the scope defined in this specification.

3.29 All Process Bus & Station level bus equipment should be Conformal coated as per environment standard. The equipment shall be suitable to sustain & performe in harsh environment. The equipment ingress protection class shall be IP64.

3.30 All Process bus & Station bus equipment, Ethernet Switches and other devices which are ethernet based equipment/system shall be integrated with Gateway on SNMP Protocol for Condition Monitoring of the individual equipment on SCADA. The offered equipment should support SNMP V1, V2C, V3.

3.31 All necessary hardware, software or any other item required and not covered in the RFQ & BOM for successful commissioning of the Substation Automation System & Process Bus based Digital Substation system; shall be arranged and supplied by the Bidder as a part of the scope adhering to the quality norms as per the direction and the satisfaction of the Purchaser.

3.32 All Process bus & Station bus equipment shall be managed centrally within the station in terms of configuration, Firmware etc., upgradation & deployment of any firmware version, Patch management & configuration of Process bus equipment shall be managed through the central system within the station by bidder as part warranty clause.

3.33 Bidder to provide the details/improvement on Cyber security perspective of the offered equipment/system. Bidder shall provide a baseline document on Cybersecurity, covering features/functionalities/settings/minimum measures/standard compliance for all offered equipment/system. Bidder to include the checkpoints as a part of baseline document which will be verified /checked by Purchaser during FAT & SAT.

3.34 Any defect or troubleshooting on Process bus equipment should be addressed by the bidder within 24hours from the time of reporting the problem.

3.35 Bidder shall consider Services from the Gateway & DRCA OEMs for configuration, testing & integration with Unified SCADA System.

Sl.no	Station Name	Gateway Make & Model	DRCA Make & Model
1	Kolshet	ABB (APPSIL) & MicroSCADA	Kalkitech & Syn3000& RAS

Table-1

3.36 Integration of proposed protection IEDs with existing Disturbance Record Collector Cum Analyzer (DRCA) systems at Station level as well as Purchaser's centralized DR system. The technical scope includes Auto DR, Relay parameterization, configuration management, fault record collection & analysis.

3.37 The Auxiliary relay of the Digital Outputs shall have minimum 2 Normally open (NO) Contacts.

3.38 All DO Output terminal blocks (output contact from Aux.relay) shall be mounted vertically (Assuming the channels are horizontally mounted) and the field cables will be connected at the bottom of the terminal block. Bidder shall consider the suitable size of Cable Trough (Both vertical & horizontal) and routing accordingly. The Cable trough should have minimum 50% free space to cater the field cables.

3.39 It is bidder responsibility to design the panels and propose to Purchaser considering all maintenance aspects viz. free access to the equipment, removal during repair/failure, Field wiring/cabling. Also, Bidder should also take care the Equipment wiring, routing of cable FO cables, wiring from equipment to Terminal blocks etc. with enough length and appropriate lugs & appropriate labels for equipment & Cable identification.

3.40 Supply of an Engineering station (laptop) with fully pre-loaded; related software & applications for configuration, diagnostics, simulation & testing. Bidder to supply licensed copies of all the preloaded software.

3.41 Bidder shall ensure the Segregation of network (VLANS) with proper configuration, inbound and outbound network filtering on all the interfaces. Separate network shall be established for each function defined in the specification which includes protection System and communication of process bus and station bus.

3.42 IP scheme shall be as per purchaser requirement and as per the existing WAN. The IP schematic will be provided by the Purchaser. However, bidder shall propose the IP scheme (for reference) and also provide the implementation procedure for the offered solution.

3.43 Bidder shall provide all the necessary cables, termination kits and accessories for commissioning of Sub-Station Automation system. Cable supply, laying and termination for

powering up and networking of the supplied equipment's and connectivity to the Masters (within the premises).

3.44 All Inter panel shall be armored/unarmored for Process bus & Station bus integration.

3.45 All Intra panel wiring shall be through cable conduit. All FO patch cords shall be ruggedized.

3.46 Bidder shall submit single Signal list (I/O list) and ICS for Substation Automation for the entire station. The ICS shall include the either end terminal details with Cable type, size etc.,

3.47 Bidder shall consider and supply the Universal IEC61850 configuration tools for configuration, parameterization, maintenance and troubleshooting of offered IEDs and gateway.

3.48 All software supplied shall be licensed and shall be in the name of the Purchaser. Bidder should offer the latest software & Firmware of the SAS products which is tested and proven. Bidder shall provide all documentation in soft/ hard form about licensing information for each software supplied (OS, application software's of IED, other Application software's, configuration, diagnostics, simulation & testing tools).

3.49 Bidder to submit the architecture drawing and indicative bill of material along with the offer.

3.50 Demonstration / Testing of the fully configured system at Bidder's works before dispatch of the system at site (FAT). The factory inspection shall be integrated FAT of protection (including Process Bus equipment) , automation and communication system at a common work place . The inspection shall also cover cybersecurity requirements. The inspection will be conducted as per the FAT procedure document to be submitted by the bidder during detailed engineering and approved by Owner after review.

3.51 Installation, testing & commissioning of the system including integration and configuration with Purchaser's existing systems, sub-vendors' systems & other systems and performance.

3.52 Submission of technical documentation related to design, construction/as built, testing, operation & maintenance of the equipment and submission of Test Reports, job progress reports etc. in hard copies (4 sets) and soft copies (3 sets, in PDF & AutoCAD).

3.53 Site Acceptance Test (SAT) to the Purchaser's satisfaction (as per the SAT document submitted by the bidder during detailed engineering and approved by the owner after review) with the completion of the following, in minimum:

a. Testing of the proposed Sub-Station Automation System from the Purchaser's SCADA systems.

b. Demonstration of system response

c. Integration of all supplied equipment under the contract.

d. Certification on Cybersecurity Measures Complied as per the design consideration by the bidder

3.54 Training of Purchaser's Personnel at site and Bidder's works with all required training setup for each individual trainee.

3.55 Supply of recommended and mandatory spares for all supplied items as mentioned in the separate section.

3.56 Bidder shall provide extended warranty for additional 3 years over and above as mentioned in relevant clause of GCC (which is 2 years) for the supplied protection, automation and communication equipment of this package including 3rd party products. Bidder shall consider the scope for warranty as specified in the specifications.

3.57 Bidder shall provide warranty for 10years for Process bus based Digital Substation and accessories package including 3rd party products. Bidder shall consider the scope for warranty as specified in the specifications. This shall covers complete patch management , firmware and software upgrades for the entire warranty period.

3.58 Maintenance of the system during warranty period and post warranty maintenance as specified. Providing software upgrades and modifications.

3.59 Indicative I/O list, Bill of material and Data sheets attached in this specification are only for reference for bid purposes. Details provided in these documents are minimum requirement of the purchaser. It is the responsibility of the bidder to meet the functional requirement as specified in the specification.

3.60 Unless specified otherwise, Bidder shall consider the products of quality, industrial grade & reputed make with replacement warranty, spares availability & maintenance support as per this specification document which applies for all SAS items.

Bidder shall note that, it is not the intent of this specification to specify completely herein, all details of design & construction of Sub-Station Automation system. However, the bidder shall include and supply the required material and resource at any stage of the project for successful and complete commissioning of the system.

4.0 CODES AND STANDARDS

The design, manufacture and performance of the Sub Station Automation System shall comply with all the requirements of the latest editions of international codes and standards applicable. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Emissions Standards		
1	EN55011 (CISPR 11)	ISM RF Equipment – Electromagnetic Disturbance Characteristics

2	60255-25	Electromagnetic emission tests for measuring relays and protection equipment
3	61000-3-2:2000	EMC-Limits for harmonic current Emissions.
4	61000-3-3:1994+2001	EMC Limits-Limitations in voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.
Immunity Standards		
1	61000-4-2 1995-01 60255-22-2 IEEE C37.90.3	Electrostatic discharge (ESD) immunity test
2	61000-4-3 1998-11, 60255-22-3 IEEE C37.90.2 (10V/m)	Radiated, radio-frequency electromagnetic field immunity test
3	61000-4-4 1995-01, 60255-22-4, IEEE C37.90.1	Electrical fast transient/burst immunity test
4	61000-4-5 1995-02	Surge immunity test
5	61000-4-6 1996-03	Immunity to conducted disturbances, induced by radio-frequency fields
6	60255-22-6	Electrical fast transient/burst immunity test
7	61000-4-81993-06	Immunity to power frequency magnetic fields
8	61000-4-12	Oscillatory waves immunity test
9	1995-05, 60255-22-1, IEEE C37.90.1	(Damped Oscillatory and Ring wave)
Safety		
1	61010-1	Harmonized Safety Standard
2	60255-5 2000-12	Insulation coordination for measuring relays and protection equipment- Requirements and tests
Power Supply Standards		
1	61000-4-11 1994-06	AC Power supply interruptions
2	61000-4-16 1998-01	Immunity to conducted, common mode disturbances.
3	61000-4-17	Ripple on D.C. power supply

4	61000-4-29+2000-08, 60255-11	Voltage dips, short interruptions & voltage variations on D.C. input power port immunity test
Environmental Standards		
1	60068-2-1 1994-05	Environmental Testing Cold
2	600068-2-2 1974	Environmental Testing Dry Heat
3	60068-2-6 1995-03 60255-21-1	Environmental Testing Vibration tests (sinusoidal)
4	60068-2-27 1987	Environmental Testing Shock
5	60068-2-29 1987	Environmental Testing Bump
6	60068-2-30 1980	Environmental Damp Heat cyclic (12+12-hour cycle)
7	60068-2-31 1969	Environmental Testing Drop and Topple
8	60255-21-2	Shock and bump tests
Communication Standards		
1	61850-3 IEEE 802.3 CSMA/CD	Substation Comm. Standard access method and physical layer specifications
Cyber Security Standards		
1.	IEC62351	Security in Automation Systems
2.	IEC 62443	Cybersecurity standards are multi-industry standards listing cybersecurity protection methods and techniques
3.	IEEE1686	
4.	NERC CIP	(CIP-003, CIP-005, CIP-007)
5	Guidelines	CERTIN , NCIIPC, ISO27001
Process Bus & Station Bus Equipment Standards		
1.	IEC 61850 Standard (Ed2), IEC61850 Standard (Ed1)	
2.	IEC61850-9-2 (LE)	
3.	IEC61850-8-1, IEC61850-3, IEC61850 – Part6 (SCL), PRP & HSR as per IEC62439 Standard.	
4.	IEEE1588V2 (PTP) for Process Bus, SNTP Time Server (v2, v3 and v4) for Station Bus, SNMP v1, v2c and v3 for device management.	

The proposed automation system shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

5.0 DESIGN REQUIREMENTS

5.1 The Substation Automation System shall be designed such that it facilitates both local and remote monitoring with priority for remote monitoring. The Substation automation system shall enable complete unmanning of the sub-station and allow for complete remote monitoring and control from Purchaser's Power System Control Center (PSCC)

5.2 The Automation system design shall be based on distributed architecture with central monitoring and control in line with existing Unified SCADA and SAS implemented across Tata Power.

5.3 The systems shall be State-of the art system; based on IEC61850 standards for operation under electrical conditions present in high-voltage substations.

5.4 All SAS components supplied as a part of this specification shall be industrial grade suitable for 24x7 operations and equipment shall be selected accordingly by the bidder.

5.5 Bidder should offer the latest software, firmware of the equipment which tested, proven and in service.

5.6 The offered product shall comply to all open protocols such as IEC 61850 (including 9-2LE) Ed1 & Ed2, C37.94, etc. and compatible with all other OEM's products. Any interoperability issues arising during commissioning and during guaranty period, bidder shall undertake to resolve them within 2 months (maximum) period

5.7 The offered MUs, SCUs, BCU, Protection relays shall have flexibility in supporting all Logical Nodes mainly control functions such as CSWI, CILO etc. in the offered products.

5.8 The Bidder shall follow the latest engineering practices & ensure compatibility requirements, continuity of equipment supply and the safety of the personals. All required safety interlocks and fail-safe logics shall be incorporated in the system wherever required.

5.9 Redundancy shall be ensured y in both process Bus & Station Bus level equipment in terms of processor/device, ports and path of communication to ensure reliability & availability. There shall be no single point of failure in the system.

5.10 The system shall be designed such that maintenance, modification or extension of components shall not cause a shutdown of the whole system.

5.11 The system shall be self-healing without human interventions. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

5.12 The systems shall be modular in nature and shall be capable for expansion to meet future requirement.

5.13 The substation automation system shall be designed and implemented using the best Cyber Security practices. The system shall provide in minimum the following features viz. Authentication, Authorization, Audit Trails, Network segregation, backups, ports hardening, virus/malwares/ransomware prevention, intrusion prevention and detection.

5.14 All Offered Equipment under Process bus & Station Bus including communication devices shall generate Syslog and pushed it to both Purchaser's Cybersecurity management System and SOC. The equipment shall store minimum 1month data with FIFO.

5.15 All substation automation system shall be designed with 110V/220V DC redundant power supply.

5.16 All protection and automation system shall be time synced and shall have the same reference time i.e. from the station GPS. The station GPS shall have multiple IEEE1588 V2 and SNTP ports to synchronize the Process Bus and Station bus equipment.

5.17 Time Synchronization Sampled Voltage & Sample current must have same time to ensure error free measurement/blocking.

5.18 All Panels shall be provided with redundant Diode OR-ing units in the DC schematic circuit.& any other solutions.

5.19 All Automation Panels will have Louvers & FAN arrangement (min.2nos). The Panel shall be either front Swing frame or front fixed and the rear side shall be double door type. The Panel IP class shall be IP55.The Panel shade shall be Siemens Grey (RAL 7032).

5.20 The Configuration of the Process Bus & Station Bus equipment should be flexible in terms of following, without affecting the response time.

a. GOOSE Mapping & exchange between Relays

b. GOOSE Mapping & exchange between MUs/SCU to CRP & BCU

c. Relay & MU/SCU configuration software flexibility with various combination of communication failure & redundancy.

5.21 **Process Bus**

a. Redundant Merging Unit along with SCU for protection scheme shall be per bay as per the Configuration details mentioned in ***the Digital Substation Protection Specification***

b. Non-redundant Switchgear Control Unit (SCU) with Minimum 64DI/20DO shall be considered to accommodate the respective Bay related I/Os to BCU on Station Bus Communication.

c. All Process Bus Units are Conformal coated as per Environmental Standards and IP class shall be IP64.

d. All MUs, SCUs, MFM and Communication accessories of the respective bay shall be mounted in the Process Bus Panel.

e. Communication Ethernet switches shall be compliant for PRP and the network shall be built accordingly.

f. Redundancy Communication media and network shall be considered on all aspects viz. Equipment (Active/Passive), Cable, Communication Path and Communication Port)

g. Fibre cables should be laid on physically different route i.e each cable should follow a different route. Fibre cables should be armoured and double HDPE jacket type.

h. All Process Bus equipment shall have redundant and shall be on Station DC (110vDC / 220v DC).

i. The Communication network between Process Bus and Station Bus shall be independent.

j. Communication Infra structure & Network shall be designed considering worst case scenario (example: furious tripping). In such case, the Communication system should not get affected in terms of response time and performance of both Process Bus and Station Bus.

k. Communication network design at the station bus and process bus should be designed in such a fashion that lower network re-convergence delays are achieved. Bidder is free to propose latest network design available which may include latest functionalities such as SDN, Device redundancy etc.

l. Communication system designed should be such that looping of network should not bring the complete network down. Use of RSTP and STP to be avoided. Design should be such as that the network should be self-healing and smart to proactively provide failure alerts and help pinpointing the same.

m. Switches deployed should be capable of deploying latest cybersecurity controls such as mac binding, VPN encryption of outflowing streams etc. Network access control techniques to be deployed along with IDS, IPS and anomaly detection. This should be passed on as real time notifications to central system. Switches should comply to Cybersecurity requirement as per Standard Guidelines.

n. Bidder to do detailed network engineering at process bus and station bus level consideration to traffic separation using best available solutions to be proposed not limiting to VLAN.

o. The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training

p. The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records. It shall also have provisions for inhibiting control on any or all devices for purpose of maintenance. The devices under maintenance shall be provided with tags which shall include provision for entering text.

q. Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

r. The IP addressing scheme of the system shall be provided by the Purchaser.

s. The system shall be remotely accessed for collection of disturbance records and hence shall be provided with a firewall/router to comply at least with the requirements of CIP-005, CIP-007 (Critical infrastructure protection) standard as per NERC (North American Electric Reliability Council).

t. Bidder should design the communication network in such as fashion considering all the network security components not limited to firewalls at station level ensuring compliance over and above to latest cyber security guidelines by CERT-IN, NCIIPC, NERC-CIP.

u. Bidder shall adhere to the minimum design parameters as indicated in the below table

Communication network Deliverables			
Table: IEC 61850 Tolerated Communication Delays			
Communicating Partners	**Service**	**Application Recovery Tolerated Delay**	**Required Communication Recovery Time**
SCADA to IED, Client -Server	IEC 61850-8-1	800ms	400ms
IED to IED interlocking	IEC 61850-8-1	12ms (with Tmin set to 4ms)	4ms
IED to IED reserve blocking	IEC 61850-8-1	12ms (with Tmin set to 4ms)	4ms
Protection trip excluding Bus Bar protection	IEC 61850-8-1	8ms	4ms

Bus Bar protection	IEC 61850-9-2 on station bus	<1ms	Bump less
Sampled Values	IEC 61850-9-2 on process bus	Less than two consecutive samples	Bump less

5.22 **110 kV System Station Bus**

a. BCU shall be part of protection relay family and shall be for each bay.

b. BCU shall be non-redundant and shall be mounted in the protection Panel of the respective Bay. The BCU shall cater to all AIS/GIS related I/O signals.

c. All equipment command will be executed through internal digital output of BCU without any external relay interface modules. The Binary output contact of BCU DO card should have sufficient rating to execute the control command of the EHV equipment.

d. BCU shall have LED based HMI display with control function keys.

e. BCU shall provide the analog & Energy values as mentioned MFM parameter list.

f. Redundant gateway panel shall be considered for 110 kV voltage level.

g. The Gateway Panel will have redundant Layer-3 Switches for Communication with Station Backbone Communication (Stacked Layer-3 Switch).

h. Redundant GPS receiver for both Process Bus & Station Bus .

i. Station Bus Communication ethernet switches will be compliant for PRP and the network shall be built accordingly.

j. Redundancy Communication media and network shall be considered on all aspects viz. Equipment (Active/Passive), Cable, Communication Path and Communication Port)

k. All BCU, Protections relays shall be integrated to 110kV Gateway on IEC 61850 protocol on PRP network.

l. Physically, the communication networks shall be independent for Main 1 & Main 2 Numerical Relays communication with Gateway.

m. Physically, the communication networks shall be independent for BCU and Misc.RTU communication with Gateway.

n. Communication Switches for BCU, NR, Misc. RTU shall be mounted separately in a Network Panel.

o. The Gateway shall have independent port for down- stream (Ethernet ports and up-stream Ethernet ports for communication to the Automation WAN (Station L3 switches).

p. The gateway configurations shall be done in such a way that the system shall report to four independent redundant masters (Unified SCADA, Emergency Control Center, Nodal SCADA, Quality Assurance System) on IEC60870-5-104 Protocol.

q. All 110kV bay MFM will be integrated with Gateway on Modbus RTU protocol. Bidder to consider separate MFM for all Bus PTs which shall be integrated to Bus-Coupler / Bus-section bay BCUs. Not more than 10 MFMs shall be considered in a single RS-485 loop.

r. All DI signals shall be terminated in knife edge type TBs CKT4U or equivalent. For Output DO signals & Power supply, Source TBs shall have stud type droppable links (CBT4U or equivalent).

s. In Pre-wired Misc. RTU panels,2 Normally Open (NO) contacts of Auxiliary Relay in the DO circuit shall be wired in series.

t. All DO Output terminal blocks shall be mounted vertically and the field cables will be connected at the bottom. Bidder shall consider the suitable size of Cable Trough (Both vertical & horizontal) and routing accordingly. The Cable trough should have minimum 50% free space to cater the field cables.

u. A separate Miscellaneous RTU panel, shall be considered to cater to all station hardwired signals. The Miscellaneous RTU shall be suitably sized with minimum 30% spares.

5.23 The gateway shall also be used to integrate all station existing auxiliary systems including the temperature and humidity sensors, ACDB, DCDB, Battery & Battery chargers, UPS, Fire detection and protection systems, transformer condition monitoring systems, DG system and other condition monitoring systems.

5.24 **Disturbance Recorder Collector and Analysis system (DRCA)**

a. DRCA system shall be considered to cater to all the 110 kV,33/22 kV IEDs.

b. All Numerical relays shall integrate to this DRCA system through the Bay level switches/Network Panel.

c. Separate parameterization systems shall be considered along with the DRCA system

d. The DRCA system shall be connected to the Automation WAN via a firewall configured with suitable policies.

e. The DRCA shall become part of the Centralized DRCA system to enable automatic downloading of DR files and remote parameterization.

5.25 **Remote End System as per Protection Specification mentioned under Section B, Chapter - 2.3-A**

a. All numerical relays supplied as part of this project shall be integrated to the existing gateway on IEC61850 at Respective Remote ends.

b. Protection related hardwired signals shall be integrated to the existing Protection Misc. RTU.

5.26 Health monitoring /watch dog contacts of active components (IEDs, Switches, Converters etc.) shall be wired up to the terminal blocks of the respective panel and shall be further integrated with Miscellaneous RTUs

5.27 All MCBs shall have auxiliary contact for monitoring the status & should be wired on the link inside respective panels.

5.28 All Fiber/CAT6 cables for inter and intra panel shall be armoured, unarmoured for integration of IEDs. All Inter panel wiring shall be through cable conduit

5.29 MFM shall be part of Protection Panel and shall be integrated with the existing Gateway. Bidder shall consider the Ethernet Switches, Communication cable & Patch cords and accessories accordingly.

6.0 LAYOUT REQUIREMENTS

6.1 All systems shall be installed based on the approved equipment layout and plot plan.

6.2 Communication switches for numerical relays shall be mounted in the Protection panel or separate network switches near the protection panel-based space availability. The same shall be finalized during detailed engineering.

6.3 The Gateway Panel and Miscellaneous RTU Panel shall be in the Relay Room / Switchgear room along with Protection and Communication panels.

6.4 The GPS clock with receiver shall be installed in the Gateway panel. The remote display units for Time and Frequency shall be wall mounted in the Control room (or) Relay room at an appropriate place.

6.5 Temperature and Humidity Sensors shall be installed in the control rooms, GIS halls/Outdoor AIS locations, Switchgear room, Battery room and terrace/building outside

7.0 OPERATIONAL AND MAINTENANCE REQUIRMENT

7.1 OPERATIONAL REQUIREMENTS

a. The system shall be user-friendly and suitable for remote operations and control from existing/new Unified SCADA system.

b. Any failure or disturbance in the substation shall be annunciate to PSCC via the SCADA system as per Tata Power's operation philosophy.

c. The system shall facilitate safe and secure operations of all the equipment.

d. Configuration and all logics, GOOSE messaging of the Process Bus & Station Bus equipment shall be retained in non-volatile memory (i.e. after a power cycle the IEDs shall restore in its normal state or as configured.

e. Wherever local and remote operations are possible, selector button shall be made available both in local as well as remote. The selection of local/remote mode of operation shall be reported to the SCADA system.

f. BCU/RTU rack shall have rear enclosure and cable tray for routing the IO cables.

g. Proper Rating of MCB, Power supply Units, Converters etc., to be selected. Appropriate & Suitable lugs, Wires and terminal blocks to be selected during design of Panel & Equipment.

h. Opto-coupler isolation for all DI/DO/AI cards along with LED indication for each input & Outputs

7.2 **MAINTENANCE REQUIREMENTS**

a. Bidder shall provide facilities for carrying out online and offline maintenance of the components supplied as a part of the system. In general, this should include adequate testing equipment, tools, safety devices and other accessories. Bidder shall provide the details in their bid.

b. Bidder should provide Maintenance strategy of the product being offered so as to schedule appropriate timeline for maintenance.

Warranty :

a. Bidder shall warrant that the equipment including software, hardware, firmware and associated documentation are free of defects in material and workmanship and from defects or faults in design, in so far as the equipment fails to meet the requirements of this technical specification, bidder to adhere to the warranty clauses mentioned in the GCC/Section-A of this RFP from the date of final acceptance by the Tata Power after completion of 30 days trouble free operation.

b. With respect to defects in equipment part, Bidder's liability is to make good by replacing the faulty equipment. It is the responsibility of the Bidder to replace the faulty equipment within 7 working days.

c. During the warranty period, the bidder shall upgrade the firmware of the modules with the latest available. This activity shall be carried out free of cost at site as and when the patches are released. Sample testing for the operation of devices and associated equipment shall be carried out after the Up gradation of any software.

d. After replacement of the faulty equipment, the Tata Power shall return parts that are defective to the Bidder. The Bidder shall cover the cost associated with the shipping of defective or failed items during warranty period. The new equipment, parts shall be delivered to the Tata Power facility CIF (Cost, Insurance, and Freight) free of charge.

e. With respect to software, the Tata Power shall notify the problem to the Bidder, including a detailed description of the deficiency and associated condition. Bidder shall guide the Tata Power for corrective action. If the same is not resolved, the Bidder shall depute his personnel

to attend the same within 24 hours from the time of reporting the problem. The system Bidder shall be fully responsible to resolve hardware and software deficiency reported by the Tata Power.

f. With respect to third-party software and consumable parts supplied, the Bidder shall make reasonable effort to obtain the best warranties possible from the sub-Vendor thereof and assign to the Tata Power any such warranties to the extent that such warranties may be assigned to the Tata Power.

g. Bidder may consider longer warranties than included in these specifications.

h. Bidder shall extend all warranties / guarantees to the Tata Power, provided by sub- Vendors, of duration longer than that in this specification.

i. Upgrades & Modifications: Bidder shall continuously keep the Tata Power informed of all Software and Hardware upgrades as & when these are released.

j. Bidder shall supply upgrades of all installed software (both own and third party) for a period of five years from the date of system acceptance without any commercial implication.

k. Bidder shall rectify all design defects and software bugs at no extra cost for a period of 5 years from the date of system acceptance for Automation System & 10 years for process bus based Digital Substation equipment/system.

l. The system referred to above includes Bidder's own as well as third party components.

m. Bidder shall port the supplied software onto upgraded hardware (as per Bidder's standard offerings) without additional Software License Fees.

Upgrades & Modifications

a. Bidder shall continuously keep the Purchaser informed of all Software and Hardware upgrades as & when these are released.

b. Bidder shall supply upgrades of all installed software (both own and third party) for a period of five years from the date of system acceptance without any commercial implication.

c. Bidder shall rectify all design defects and software bugs at no extra cost for a period of 5 years from the date of system acceptance

d. Bidder shall provide lifetime support (15 years) for the system, even if no upgrades are implemented.

e. The system referred to above includes Bidder's own as well as third party components.

f. Bidder shall port the supplied software onto upgraded hardware (as per Bidder's standard offerings) without additional Software License Fees.

g. The proposed Software & tools for Digital Substation Process & Station Bus equipment shall have common/single tool to manage configuration, Logic Building etc., All Station files such as ICD, CID, SCD, SSD, SID etc., shall be generated and managed by this tools.

Any other tools to meet the functional requirement to meet the engineering validation, inter-operability, performance & for seamless integration with SCADA to be considered by the bidder.

Support Services

a. Bidder shall have support service Centre in India to cater after sales services. Technical support facilities including qualified manpower, testing tools, instruments and integration facilities available within India

7.3 **TRAINING REQUIREMENT**

a. Bidder shall provide training to the Purchaser's personnel on the operation and maintenance of the system supplied including Non-OEM equipment/3rd Party equipment. The training shall cover development, integration, installation and commissioning of both software & hardware components of the system.

b. Bidder to consider minimum 50 man-days training for Purchaser's personnel for automation systems.

c. Bidder shall cover the topic related to Protection, Automation and Communication of the process bus based digital substation and provide detailed training at Bidder's work which can cover the entire solution viz. Standards, Products, Configuration, testing/polices procedure, Trouble shooting, O&M ,Cyber security aspects

d. The Bidder shall provide Classroom as well as hands-on training on the system. All required training materials such as system catalogues, test instruments, demo equipment, and simulation jigs, etc. shall be provided by the Bidder. The training shall equip the Purchaser's engineers for installation, commissioning, operation and post-warranty maintenance of hardware, software (Operating System, Administration and Applications), protocols and all third-party systems.

e. All clauses related to Transport, Lodging & Boarding, Local transport for Owner's personnel etc. shall be as per the terms and condition defined in the GCC/Section-A.

f. Factory training shall be immediately prior to FAT. Site Training shall be prior to commissioning on a mutually convenient schedule.

g. Bidder shall indicate their Training facilities including test tools and simulation facilities. Bidder shall provide the training calendar & details of topics considered for the equipment offered.

h. General requirements relating to the training are specified below:

i. Personnel who speak understandable English and who are experienced in instruction shall conduct training courses.

ii. Bidder shall provide all necessary training material. Each trainee shall receive individual copies of the technical manuals and pertinent documents.

iii. The Purchaser shall be permitted to video tape all training classes.

iv. Class materials, including documents sent before the training classes and class handouts, shall become the Purchaser's property. The Purchaser may copy this material for in-house training and use only.

v. Training sessions shall accommodate the number of candidates as per the contract.

vi. Bidder should have training facility with VC such that remote end teams who cannot be deputed can join thru VC. People attending training on VC will not be part of training man days.

8.0 TECHNICAL PARAMETERS OF EQUIPMENT INCLUDING DATA SHEET

8.1 Process Bus - Switchgear Control Unit (SCU)

The Switchgear control Unit (SCU) shall be part of Merging Unit family & protection relay family and shall be dedicated for a single bay.

The SCU shall acquire and process all hardwired signals from bay equipment viz. Breaker, Isolator and Earth switch etc and related signals. SCU shall function as digital interface between switchgear and control & protection IEDs (bay level IEDs) and shall be installed in the Process Bus Panel.

The SCU shall be non-Redundant and shall be per Bay. The Minimum Configuration of the SCU shall 64BIs/20BO/0AI.

The SCU shall have Minimum requirement & features as mentioned below but not limited

1. Comply to IEC61850-9-2LE standard and all relevant IEC61850 Standards both Ed1 & Ed2
2. Pluggable, modular and scalable
3. High Speed switching/tripping < 1ms
4. Support IEEE1588V2/PTP
5. Supports GOOSE and MMS
6. Redundant Power supply.
7. Supports PRP Communication Network
8. Shall have Redundant Fiber Optic Port with 100/1000 Mbps

9. Conformal Coated as per environmental Standards to sustain Harsh environment.
10. Ingress Protection IP class shall IP64 or Suitable for Outdoor environment.
11. Environment temperature range -40 degree Celsius to 70 degree Celsius.
12. No restriction in Functional Logics, Calculations, Variables, Function blocks etc. for interlock building.
13. Secure access to device through Web browser without any software installation.
14. It shall have Indicating LEDs for local diagnostics of the BCU health & all I/O points.
15. Device shall be test certified by KEMA or equivalent laboratory
16. Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.
17. The Power supply of the SCU shall be rated between 80V DC to 250V DC. The Binary input switch voltage shall be settable between 80V to 250 VDC and the Binary Output shall be heavy duty which shall have breaking capacity of 10Amps.
18. Potential free contacts of health check (such as failure of communication, power supply and CPU) shall be provided for SCU, which shall be wired to miscellaneous RTU panel.
19. User friendly on-line health and data monitoring facility shall be provided to maintenance engineer for monitoring/analysing the real time step by step status of the process, program logic from the engineering station (Configuration tool – Laptop).
20. The SCU shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of SCUs shall be compatible with the overall system communication and data exchange requirements.
21. In case of power supply failure, auto start-up and restoration of the SCUs shall be possible without manual intervention
22. Configuration and all logics, GOOSE messaging of the Process Bus & Station Bus equipment shall be retained in non-volatile memory (i.e. after a power cycle the IEDs shall restore in its normal state or as configured.
23. SCU shall offer Binary input processing (Single point, double points, multiple points, system input and logic input), all acquired, and time stamped at <1 msec accuracy and discrimination.
24. The Master Station user shall be able to perform a virtual connection with SCU through gateway for Remote database downloading, uploading of configuration parameters, firmware changes, etc. of SCU from master station shall be provided using a web interface
25. The field wiring shall be terminated such that these are easily detachable from the I/O module.

26. It shall be possible to increase the number of communication ports in the SCU by addition of cards, if required in future. The SCU shall support the use of a different communication data exchange rate and scanning cycle on each port.
27. The IO cards and accessories shall be from the SCU manufacturer
28. Configuration

    Minimum BI/BO configuration of SCU per bay shall be

	Digital Inputs (DI)	Digital Output (DO)	Analog Input (AI)
SCU	64	20	0

29. The characteristic of the contact outputs per signal / command shall be adjustable via software:

i. Latched
ii. Non latched
iii. Time delayed reset

30. **Communication**

Ports

i. A galvanically isolated USB port for local engineering through laptop.
ii. Minimum 2 nos. RS 485 port
iii. 2 Nos. Fiber optic port of 100/1000 MBPS, depending on the configuration proposed by the Bidder for Station Bus Communication.

The SCUs shall be connected on Fiber Optic/Ethernet, 100/1000 Mbps and communicate with Station Bus Network.

The SCU shall support the use of a different communication data exchange rate and scanning cycle on each port.

Protocols

i. IEC61850-9-2LE, MODBUS (RTU), SNMP v1, v2c and v3, & IEEE1588 V2 communication protocol shall be available. The BCU shall meet the IEC61850 Ed1& Ed2 standard in every respect and interoperability with other manufactures IEDs. Master and slave license shall be considered for all the above-mentioned protocols.
ii. Have peer-to-peer communication using GOOSE messages for interlocking.
iii. Should be Interoperable with third party IEC 61850 compliant devices

iv. Should generate XML file for integration/engineering with vendor Independent SCADA systems

Algorithm and Logic

i. The SCU shall be based on advanced and proven algorithms for writing interlock logics, so an easy and efficient upgrade of the SCU functionality shall be possible.

ii. The interlock logics shall be User interface based (or) Functional block diagram based.

iii. Necessary advanced logical & arithmetic functions shall be available.

iv. Interlocking modules for all types of switchgear arrangements shall be available in order to avoid damaging switchgear operations and to ensure personal safety.

v. The SCU shall support interlocking via station bus and/or hardwired solutions.

vi. The SCU shall facilitate user defined logic functions such as automatic control sequences by means of available logic elements. For example with one command perform a safe change of the connection of a selected line from one busbar to another busbar in double busbar switchgear.

vii. Command is always to be given in two stages from BCU: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated (Select-before-execute). The configuration of the SCU should be done accordingly.

viii. It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and filp flops, timers).

ix. A delay/integrator shall allow the pick-up and reset of binary signals to be delayed before being displayed or used to control other functions.

Self-Supervision

i. The SCU shall have extensive self-supervision including all I/Os and communication channel.

ii. The SCU shall have LEDs for healthiness / error indication and for all digital Inputs/Outputs.

iii. SCU shall have the facility to generate and download the log files for maintenance and troubleshooting.

iv. Each bay control SCU shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

v. Command execution timer (configurable) must be available for each control level point. If the control action is not completed within a specified time, the command should get cancelled (Run Time Command cancellation). The timer for this command time-out feature shall also be configurable.

vi. In case of restoration of communication links, power supply after failure, the software along with hardware shall be capable of booting automatically & synchronize with the remaining system without any manual intervention.

vii. It shall be possible to re-boot the MU/SCU through the LAN/WAN through remote.

Disturbance & Event Recording

i. An event recorder that can handle up to 1000-time tagged events shall be included. The sequence of events shall be stored in non-volatile memory.

ii. The SCU shall have an internal clock with the stability of 10 ppm or better. The SCU time shall be set from time synchronization messages received from GPS receiver/gateway. SOE time resolution shall be 1 microsec or better.

iii. The SCU shall maintain a clock and shall timestamp the digital status data. Any digital status input data point in the SCU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the SCU shall time-tag the change and store in SOE buffer within the SCU. SOE shall be transferred to BCU through GOOSE Messaging.

iv. It shall be possible to retrieve the recorded event on the Purchaser's SCADA system.

v. All recorded disturbance data from the SCUs shall be automatically uploaded (event triggered or once per day) to a Purchaser's SCADA Systems through Station Bus/station equipment.

Control and Monitoring

i. The system shall incorporate the control and monitoring, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

ii. Supervision of mA input signals from transducers shall be possible to include.

iii. The operation shall depend on the conditions of other functions, such as interlocking, etc.

iv. Monitoring of Realtime status of the logic & its output in the configuration

Input/ Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide interface to the substation equipment. All the status of the switchgears of a bay should be taken to the bay SCU. Status of any field equipment of a bay should be taken to that bay SCU. The digital inputs shall be acquired by exception with 1 ms resolution, contact bouncing in digital inputs shall not be assumed as change of state. Connections from SCU to switchgear should not terminate directly on I/O boards but shall be through Field Interface Module/Terminal blocks (TB). However, the control command from the SAS for the operation of switchgears should be routed through the bay BCU.

Engineering Functions

i. A tool for user friendly engineering and disturbance handling shall be available.

ii. Configuration of all input and output logical signals and binary Inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

iii. It shall be possible to access all process bus equipment from Master Station for configuration/maintenance activity. This shall have minimum multilevel passwords to safeguard bay control, logic, and automation settings.

iv. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analysing the real time status of the process, program logic from the engineering station (Configuration tool- Laptop)

v. The configuration software should be able to configure control, protection, inputs, outputs, etc. The software should also have provision to view all the electrical parameters. Actual conditions of all inputs, outputs, protection and control elements.

vi. The software should allow configuration of the IED with different versions.

vii. It should be possible to configure the IED for its protocol settings.

viii. For IEC 61850 protocol, the ICD file generation should be possible through this software.

Major Test Functions but not limited

i. Vendor to provide the detailed test procedure for testing the SCU functionalities using IEC61850, GOOSE messaging & mapping and protection scheme Implemented / proposed. Vendor to ensure the required hardware and software to test the above at the time of FAT and SAT.

ii. The protection & Automation system shall support a test mode where it shall be possible to set or reset binary Input signals, signalling and tripping contacts individually or in groups.

iii. All output relay contacts can be blocked via a setting and configuration program.

iv. Using the test function, it shall be possible to set or reset signalling and tripping contacts individually.

v. A test sequencer for the local bay protection functions shall be part of the user Interface program. Virtual current, voltage and binary signals shall be programmable In a minimum of six different sequences to verify the correct operation of the respective functions and settings in the respective bay unit.

vi. It shall be possible to run these test sequences and simulations during normal operation, i.e. without affecting the station protection system in service. Re-use of saved test sequences shall be supported.

31. Cybersecurity

i. **Secure access-** Level Wise enabling of settings with User Rights should be incorporated with Password protection. Each User shall have his/her own User Id & Passwords.

ii. User Credentials to access SCU shall be authenticated through Purchaser's Active directory Server.

iii. **All actions/modifications/deletions shall be logged in the BCU.** These logs shall be pushed to both Purchaser's Central Asset/Cybersecurity Management system and SOC.

iv. It shall be possible to access the BCU through a web browser (Https Support) anywhere from the LAN for configuration, diagnosis, monitoring, file upload & download through SFTP, simulation and log retrieval by using appropriate user account management viz. Role based access control & password complexity

v. The SCU should also supports Authentication and Authorization of individual users, Security logging.

vi. SCU shall be NERC-CIP/NIST 7628, IEC 62443, IEC62351 and IEEE 1686 compliant.

vii. SCU shall be enabled with System hardening viz. disabling/removal of unused ports and services.

Bidder shall provide all cybersecurity related documents and related checklist which shall be demonstrated during FAT

8.2 **Bay Control Unit (BCU)**

Bay Control Unit shall be dedicated for a single bay to enable remote & local control of the bay equipment and supervision of circuit, switchgears & devices of that bay/feeder of the power system.

The bay level unit shall be from protection relay family and shall use industrial grade components., based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of analogue signals.

The Bay Control Unit shall have LED based HMI display for where SLD can be built and control operations can be performed through dedicated function key. The BCU shall also have L/R key for the selection of local & remote operations.

It shall incorporate select-before-operate control principles as safety measures for operation via SCADA System. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording, arithmetic, logical and trigonometric calculations and shall provide inputs for status indication and outputs for commands. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other system. The bay unit shall have the capability to store all the time stamped data at least for 30 days.

BCU along with signal conditioning interfaces, terminal blocks/Field interface module and auxiliary relays shall be installed in the respective LCP panel for bay related input/outputs.

It is proposed to build the bay related logics in each BCU, which are specific to that particular bay and common logic can be built in the Gateway. Interlock logics of the similar bays shall be same, so that in case of BCU failure or corruption in database, database of the similar bay can be downloaded in the replaced module, this will help reducing the downtime of the system and ease of maintenance.

The system shall comprise the following in-built sub-system namely fail safe control (i.e. in built check-before-execute feature), Interlock and Sequential Logic Control system, Sequence of Event Recording (SER) system and Interfacing with third party IEDs (e.g. Multifunction meters, condition monitoring equipment etc.), direct GPS clock connectivity, through SNTP server or through the Gateway on IEC 61850 / IEC 104 (main and standby mode) for time synchronization. BCU shall support redundant time synchronization inputs.

The Bay level unit/units shall be equipped with binary inputs/outputs for handling the control, status monitoring functions. Interlocks (if any) are to be incorporated in the BCU so as to permit control from the Bay level unit / local, with all interlocks in place, during maintenance and commissioning or in case of contingencies when the SCADA System is out of service. Bidder to note that control from T & C switch shall be independent of logic built in BCUs.

The BCUs shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

The following scheme / features shall be available:

1. Bay Control Unit shall be dedicated for a single bay to enable remote & local control and supervision of switchgears & devices of that bay/feeder of the power system. The BCU shall be suitable for control, monitoring and protection of circuit breakers, disconnectors and earthing switches for all types of switchgear configurations up to the highest voltage levels.
2. The Input / Output capacity of BCUs shall cater all specified requirement.
3. The System shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.
4. The IED shall be suitable for control, monitoring and protection of circuit breakers, disconnectors and earthing switches for all types of switchgear configurations up to the highest voltage levels.
5. The BCU shall be with min. 750 I/O tags. However additional requirement of soft tags will be reviewed and finalized during detailed engineering.
6. BCU communication protocol shall be configured to report analog & Status changes by exception to master stations. However, BCU shall support periodic reporting of analog data

and periodicity shall be configurable from 1 sec to 1 hour. Digital status shall have higher priority than the analog data. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit.

7. All status inputs shall be scanned by the BCU from the field at 1 millisecond periodicity.
8. The standard 19” modular case of the BCU with a user-selected number of plug-in modules will provide a flexible solution for easy integration of the devices into the substation.
9. The XML based Substation Configuration Description Language (SCL) of IEC 61850 configuration interfaces shall allow information to be shared between the various configuration tools, reducing the overall engineering time.
10. The BCU shall support programming language (Functional Block) with arithmetic & logical functions to incorporate Interlock Logic for SCADA Controls. Bidder to ensure supply of necessary hardware and software to achieve the functionality.
11. It shall have Indicating LEDs for local diagnostics of the BCU health & all I/O points.
12. For IEC 61850 compliance, the device shall be test certified by KEMA or equivalent laboratory.
13. The device shall have PICS, MICS & TICS & PIXIT files.
14. BCU shall be PRP compliant for communication redundancy.
15. It shall support device interoperability using IEC 61850 ed-1 & IEC61850 ed-2 & GOOSE communication accordingly.
16. BCU shall be capable of providing all Analog & Energy values which are currently mentioned under MFM parameter list.
17. BCU should not have any limitation in terms of number of Logics , Calculation, Variables, Function blocks etc.,
18. Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.
19. BCUs shall be time synchronized with the GPS clock on SNTP protocol or on IEEE 1588 V2 protocol, and subsequently BCU shall synchronize all its slave IEDs.
20. The BCU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The BCU shall be set to capture contact operations of 10 ms or more duration. Operations of less than 10 ms duration shall be considered no change.
21. A manual Local/Remote selector switch shall be provided for each BCU to disable all control outputs by breaking the power supply connection to the control outputs. When in the "Local" position, the Local/Remote switch shall allow testing of all the control outputs of BCU without activating the control outputs to field devices. A status input indication and control shall be provided for the Local/Remote switch to allow the SCADA system to monitor and control the position of the switch.

22. Connections from BCU to switchgear should not terminate directly on I/O boards but shall be through Field Interface Module/Terminal blocks (TB). Stud type droppable terminal blocks (CBT4U) shall be used for all digital outputs along with interposing relays (Omron relay contacts in case if the existing the BCU digital output contacts required external relay), power supply and analog inputs whereas disconnecting type (knife edge CKT4U) terminal blocks shall be used for all digital inputs.
23. In case of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed within this time period, the status change shall not be accepted as valid.
24. Potential free contacts of health check (such as failure of communication, power supply and CPU) shall be provided for BCUs, which shall be wired to miscellaneous RTU panel.
25. User friendly on-line health and data monitoring facility shall be provided to maintenance engineer for monitoring/analysing the real time step by step status of the process, program logic from the engineering station (Configuration tool – Laptop).
26. The Master Station user shall be able to perform a virtual connection with BCU and other IED connected to the BCU, to support the information transfer from and to the IEDs. For example, the Master Station shall gather on-demand IED data; visualize IED configuration parameters, and IED source code depending upon the IED capabilities. Remote database downloading, uploading of configuration parameters, code changes, etc. of BCU from master station shall be provided using a web interface.
27. The BCU shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of BCUs shall be compatible with the overall system communication and data exchange requirements.
28. In case of power supply failure, auto start-up and restoration of the BCUs shall be possible without manual intervention.
29. BCU shall provide Programmable DO, DI, LED based on IEC 61131-3.
30. The Bay level unit, Gateway shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850 and other IEC standards. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.
31. BCU shall offer Binary input processing (Single point, double points, multiple points, system input and logic input), all acquired, and time stamped at <1 msec accuracy and discrimination.
32. BCU shall perform the control operations of the equipment without any external/auxiliary relays. The proposed Binary I/O cards have inbuilt optical isolation for the seamless operation of status & control of the equipment.

33. The optocoupler input voltage of BI & BO shall have a wide range of DC input voltage from 48 - 250 VDC.
34. The Master Station user shall be able to perform a virtual connection with BCU through gateway for Remote database downloading, uploading of configuration parameters, firmware changes, etc. of BCU from master station shall be provided using a web interface
35. The field wiring shall be terminated such that these are easily detachable from the I/O module.
36. It shall be possible to increase the number of communication ports in the BCU by addition of cards, if required in future. The BCU shall support the use of a different communication data exchange rate and scanning cycle on each port.
37. The proposed BCU shall be SSL/VPN, NERC/CIP compliance.
38. BCU must have the provision to configure the IP of the Gateway (Socket IP) in the Unit.
39. The IO cards and accessories shall be from the BCU manufacturer
40. The BCU database shall be MS-Excel based for easy configuration, export & import of database file.
41. The characteristic of the contact outputs per signal / command shall be adjustable via software:
    i. Latched
    ii. Non latched
    iii. Time delayed reset
42. **Communication**

Ports

i. A galvanically isolated USB port for local engineering through laptop.

ii. Inbuilt dedicated 2 set (1set = tx & rx) of Fiber optic ethernet port with 100/1000 MBPS for Station Bus.

iii. Inbuilt dedicated 2 set (1set = tx & rx) of Fiber optic ethernet port with 100/1000 MBPS for Process Bus Communication.

iv. Minimum 2 nos. RS 485 port

v. Communication network shall be PRP Network.

The BCU shall support the use of a different communication data exchange rate and scanning cycle on each port.

Protocols

i. IEC61850-9-2 (LE), IEC61850 Ed1 & Ed2, MODBUS (RTU), SNMP v1, v2c and v3, SNTP & IEEE1588 V2 communication protocol shall be available. The BCU

shall meet the IEC61850 both Ed1 & Ed2 standard in every respect and interoperability with other manufactures IEDs for the seamless integration. Master and slave license shall be considered for all the above-mentioned protocols.

ii. Have peer-to-peer communication using GOOSE messages for interlocking.

iii. Should be Interoperable with third party IEC 61850 compliant devices

iv. Should generate XML file for integration/engineering with vendor Independent SCADA systems

43. **Algorithm and Logic**

i. The BCU shall be based on advanced and proven algorithms for writing interlock logics, so an easy and efficient upgrade of the BCU functionality shall be possible.

ii. The interlock logics shall be User interface based (or) Functional block diagram based.

iii. Necessary advanced logical & arithmetic functions shall be available.

iv. Interlocking modules for all types of switchgear arrangements shall be available in order to avoid damaging switchgear operations and to ensure personal safety.

v. The BCU shall support interlocking via station bus and/or hardwired solutions.

vi. The BCU shall facilitate user defined logic functions such as automatic control sequences by means of available logic elements. For example with one command perform a safe change of the connection of a selected line from one busbar to another busbar in double busbar switchgear.

vii. Command is always to be given in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated (Select-before-execute).

viii. It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates, Filpflops and timers).

ix. A delay/integrator shall allow the pick-up and reset of binary signals to be delayed before being displayed or used to control other functions.

44. **Self-Supervision**

i. The BCU shall have extensive self-supervision including all I/Os and communication channel.

ii. The BCU shall have LEDs for healthiness / error indication and for all digital Inputs/Outputs.

iii. BCU shall have the facility to generate and download the log files for maintenance and troubleshooting.

iv. Each bay control BCU shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

v. Command execution timer (configurable) must be available for each control level point. If the control action is not completed within a specified time, the command should get cancelled (Run Time Command cancellation). The timer for this command time-out feature shall also be configurable.

vi. In case of restoration of communication links, power supply after failure, the software along with hardware shall be capable of booting automatically & synchronize with the remaining system without any manual intervention.

vii. It shall be possible to re-boot the BCU through the LAN/WAN from a remote location.

45. **Disturbance & Event Recording**

i. An event recorder that can handle up to 1000-time tagged events shall be included. The sequence of events shall be stored in non-volatile memory.

ii. The BCU shall have an internal clock with the stability of 10 ppm or better. The BCU time shall be set from time synchronization messages received from GPS receiver/gateway. SOE time resolution shall be 1 msec or better.

iii. The BCU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the BCU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the BCU shall time-tag the change and store in SOE buffer within the BCU. SOE shall be transferred to Master Station through gateway as per IEC 60870-5-104 protocol.

iv. It shall be possible to retrieve the recorded event on the Purchaser's SCADA system.

v. All recorded disturbance data from the BCUs shall be automatically uploaded (event triggered or once per day) to a Purchaser's SCADA Systems.

46. **Control and Monitoring**

i. The system shall incorporate the control and monitoring, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

ii. Supervision of mA input signals from transducers shall be possible to include.

iii. The operation shall depend on the conditions of other functions, such as interlocking, etc.

iv. All analogue & Energy values acquired/calculated shall be available to SCADA System. The abnormal values must be discarded. The analogue values shall be updated every second. The abnormal values must be discarded for Analog Measurements. The BCU shall also

calculate the 32-bit energy value viz. Mwh Import & Export, Mvarh Import & Export and should be the counter value with configured interval time (every 15minutes data) to Gateway.

v. The commands are always to be executed in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated.

47. **Power Supply**

i. Redundant Power supply module of 110V/220 DC +/- 20 % shall be available along with dedicated MCB in the protection panel.

ii. The BCU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the BCU internal logic from being damaged and becoming unstable causing mal operation.

Time Synchronization

i. BCU time synchronization shall be through GPS clock via communication ports on IEEE1588V2/SNTP.

ii. Bay controls at different system locations shall have the same absolute minimum timing accuracy.

iii. In absence of direct synchronization signal from GPS receiver, the BCU shall be synchronized through gateway.

iv. Timing Accuracy: The bay control shall time-tag event reports to an absolute accuracy of 10 µs or better

48. Environment requirements, Reliability & Cooling

i. The panels will be installed in control room buildings with no temperature or humidity control. The BCUs shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing.

ii. The Unit shall have high reliability in operation and shall not use cooling fans. The unit shall have vermin proof enclosure and shall insulate electronics, internal components and electronics from external environment in order to avoid failures due to dust, humidity, fungus etc.

49. **Input/ Output (I/O) modules**

The I/O modules shall form a part of the bay level unit and shall provide interface to the substation equipment. All the status of the switchgears of a bay should be taken to the bay BCU. Status of any field equipment of a bay should be taken to that bay BCU. The digital inputs shall be acquired by exception with 1 ms resolution, contact bouncing in digital inputs shall not be assumed as change of state. Connections from BCU to switchgear should not

terminate directly on I/O boards but shall be through Field Interface Module/Terminal blocks (TB). The control command from the SAS for the operation of switchgears should be routed through the bay BCU. For SCADA Control separate output with individual Aux relay for close and open command for each switchgear equipment shall be considered.

50. **Engineering Functions**

i. A tool for user friendly engineering and disturbance handling shall be available.

ii. Configuration of all input and output logical signals and binary Inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

iii. It shall be possible to access the BCUs remotely from the Master Station for configuration/maintenance activity. The bay control shall have multilevel passwords to safeguard bay control, logic, and automation settings.

iv. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool- Laptop)

v. The configuration software should be able to configure control, protection, inputs, outputs, etc. The software should also have provision to view all the electrical parameters. Actual conditions of all inputs, outputs, protection and control elements.

vi. The software should allow configuration of the IED with different versions.

vii. The Software should allow to integrate the 3rd Party IEDs / Non-OEMs IEDs

viii. It should be possible to configure the IED for its protocol settings.

ix. For IEC 61850 protocol, the ICD file generation should be possible through this software.

x. GOOSE Configuration tools.

51. **Cybersecurity**

i. **Secure access-** Level Wise enabling of settings with User Rights should be incorporated with Password protection in the BCU. Each User shall have his/her own User Id & Passwords.

ii. User Credentials to access BCU shall be authenticated through Purchaser's Active directory Server.

iii. **All actions/modifications/deletions shall be logged in the BCU.** These logs shall be pushed to both Purchaser's Central Asset/Cybersecurity Management system and SOC.

iv. It shall be possible to access the BCU through a web browser (Https Support) anywhere from the LAN for configuration, diagnosis, monitoring, file upload & download through SFTP,

simulation and log retrieval by using appropriate user account management viz. Role based access control & password complexity

v. The BCU should also supports Authentication and Authorization of individual users, Security logging.

vi. BCU shall be NERC-CIP/NIST 7628, IEC 62443, IEC62351 and IEEE 1686 compliant.

vii. BCU shall be enabled with System hardening viz. disabling/removal of unused ports and services.

Bidder shall provide all cybersecurity related documents and related checklist which shall be demonstrated during FAT

52. **Test Function**

i. Vendor to provide the detailed test procedure for testing the BCU functionalities using IEC61850, GOOSE messaging & mapping and protection scheme Implemented / proposed. Vendor to ensure the required hardware and software to test the above at the time of FAT and SAT.

ii. The protection system shall support a test mode where it shall be possible to set or reset binary Input signals, signalling and tripping contacts individually or in groups.

iii. All output relay contacts can be blocked via a setting and configuration program.

iv. Using the test function, it shall be possible to set or reset signalling and tripping contacts individually.

v. A test sequencer for the local bay protection functions shall be part of the user Interface program. Virtual current, voltage and binary signals shall be programmable In a minimum of six different sequences to verify the correct operation of the respective functions and settings in the respective bay unit.

vi. It shall be possible to run these test sequences and simulations during normal operation, i.e. without affecting the station protection system in service. Re-use of saved test sequences shall be supported.

8.3 Pre-wired Miscellaneous RTU Panel

The RTU unit shall use industrial grade components and shall be same of BCU family. The remote terminal unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of analogue signals. It shall incorporate select-before-operate control principles as safety measures for operation via SCADA System. They shall perform all sub-station related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording, arithmetic, logical and trigonometric calculations and shall provide

inputs for status indication and outputs for commands. The RTU shall acquire and process all data of the field (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the SCADA system either directly or through gateway. The remote terminal unit shall have the capability to store all the time stamped data at least for 30 days.

The individual/group of circuits/equipment of the power system network are controlled and supervised from dedicated lower level I/O modules in remote terminal units (RTU). The number of I/O modules shall be provided for control and supervision of all circuits / equipment of the entire power system network as specified against items mentioned in the BOM.

Pre-wired RTU panel (2300mmX800mmX800mm) along with signal conditioning interfaces, terminal blocks/Field interface module and auxiliary relays shall be provided for miscellaneous input/outputs from non-microprocessor-based relays/IEDs and for supervision and control of station auxiliary equipment's.

The system shall comprise the following in-built sub-system namely failsafe control (i.e. in built check-before-execute feature), Interlock and Sequential Logic Control system, Sequence of Event Recording (SER) system and Fault Disturbance Recording System (FDR), Interfacing with third party IEDs (e.g. Multifunction Meters, condition monitoring equipment etc.), interfacing with third party computer system, Integration of data as per time base (e.g. 15 minutes integration of energy data per feeder), direct GPS clock connectivity, through SNTP server or through the Gateway (main and standby mode) for time synchronization. RTU shall support redundant time synchronization inputs.

The RTUs shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

All analogue/digital parameters related to auxiliary system, protection devices, which cannot be directly communicated to the Gateway shall be interfaced with Protection & Miscellaneous RTU such as following, but not be limited to:

a. ACDB, DCDB, Battery Charger etc current, voltage, status.
b. Fire Alarm signals, HVAC signals etc.
c. Hardwired Protection signals (Auxiliary)
d. 415V system alarms, control and Analog signals
e. UPS, fire-fighting system, etc.
f. All automation panel & equipment's - power supply & health monitoring

The following scheme / features shall be available:

1) The Input / Output capacity of RTUs shall cater all specified requirement.
2) The System shall be based on a decentralized architecture and on a concept of function-oriented, distributed intelligence.
3) The RTU shall be suitable for control, monitoring and protection of circuit breakers, disconnectors and earthing switches for all types of switchgear configurations up to the highest voltage levels.
4) The RTU shall be with min **5000 I/O tags.**
5) RTU communication protocol shall be configured to report analog & Status changes by exception to master stations. However RTU shall support periodic reporting of analog data and periodicity shall be configurable from 1 sec to 1 hour. Digital status shall have higher priority than the analog data. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit.
6) All status inputs shall be scanned by the RTU at 1 millisecond periodicity.
7) The standard 19" modular case of the RTU with a user-selected number of plug-in modules shall provide a flexible solution for easy integration of the devices into the substation.
8) XML and SCL configuration interfaces shall allow information to be shared between the various configuration tools, reducing the overall engineering time.
9) For IEC 61850 compliance, the device shall be test certified by KEMA or equivalent laboratory.
10) The device shall have PICS, MICS & TICS & PIXIT files.
11) RTU shall be PRP compliant for communication redundancy.
12) It shall support device interoperability using IEC 61850 & GOOSE Communication
13) The RTU shall support programming language (Functional Block) with arithmetic & logical functions to incorporate Interlock Logic for SCADA Controls. Bidder to ensure supply of necessary hardware and software to achieve the functionality.
14) RTU shall be capable of communicating to Gateway.
15) All transducers mA/mV DC measurement (various ranges of DC current, Voltage) of electrical and non-electrical quantities such as Transformers Winding Temperature, Oil Temperature and Tap Position shall be wired to the Misc. RTU panel. Bidder shall consider all necessary transducers for the parameters, other than analog parameters available from the Multifunction Meters.
16) RTUs shall be time synchronized with the GPS clock on SNTP protocol or on IEEE 1588 V2 protocol, and subsequently RTU shall synchronize all its slave IEDs.
17) Digital inputs/outputs from/to Electromechanical Relays, if any, shall be connected to the miscellaneous RTU.

18) Digital inputs/outputs from/to auxiliary system, SCADA equipment's, shall be connected to the miscellaneous RTU. Potential free contacts of health check (such as failure of communication, power supply & CPU) shall be provided for RTUs, Gateways, Communication equipment; shall be wired to miscellaneous RTU panel.

19) The RTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The RTU shall be set to capture contact operations of 10 msec or more duration. Operations of less than 10 msec duration shall be considered no change.

20) To take care of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed, the status change shall not be accepted as valid.

21) User friendly on-line health and data monitoring facility shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool – Laptop).

22) The Master Station user shall be able to perform a virtual connection with any RTU/IED through Gateway, provided by the communication protocol functionality, to support the information transfer from and to the RTU/IEDs. For example, the Master Station shall gather on-demand IED data; visualize IED configuration parameters, and IED source code depending upon the IED capabilities. On the other hand, the Master Station shall be able to download to the RTU/IEDs configuration parameters, code changes, etc. depending upon the capabilities of the offered system.

23) At station level, the entire station shall be controlled and supervised from the Purchaser's SCADA System. Clear control priorities shall prevent operation of the equipment at the same time from more than one of the various control levels, i.e. SCADA system at MCC, BCC, ECC and Nodal, or equipment level. The priority shall always be on the lowest enabled control level.

24) The RTU shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of RTUs shall be compatible with the overall system communication and data exchange requirements.

25) In case of power supply failure, auto start-up and restoration of the RTUs shall be possible without manual intervention.

26) RTU shall provide Programmable DO, DI, LED based on IEC61131-3.

27) RTU shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850 and other IEC standards. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

28) RTU shall offer Binary input processing (Single point, double points, multiple points, system input and logic input), all acquired, and time stamped at <1 msec accuracy and discrimination.

29) Bidder to consider Auxiliary relays (OMRON/OEN/Paramount) for digital outputs as per the quantity mentioned in the BOM.

30) 2 Normally Open (NO) contacts of Auxiliary Relay in the DO circuit shall be wired in the series.

31) The optocoupler input voltage of DI and DO shall have a wide range of DC input voltage from 110 - 250 VDC.

32) All exposed portions (if any) of the RTU shall be covered with protective cover.

33) The field wiring shall be terminated such that these are easily detachable from the I/O module without disconnection of the field cables.

34) Remote database downloading & uploading of RTU from master station shall be available.

35) It shall be possible to increase the number of communication ports in the RTU by addition of cards, if required in future. The RTU shall support the use of a different communication data exchange rate and scanning cycle on each port and different database for each master station.

36) Internal battery backup to hold data in SOE buffer memory, time & date.

37) The proposed RTU shall be SSL/VPN, NERC/CIP compliant.

38) The RTUdatabase shall be MS-Excel based for easy configuration, export & import of database file.

39) The characteristic of the contact outputs per signal/command shall be adjustable via software:

i. Latched

ii. Non latched

iii. Time delayed reset

40) **Communication**

Ports

a. A galvanically isolated USB port for local engineering through laptop.

b. 8 nos. RS 485 port, 2 nos. RS 232 port

c. 2 Set (1 set = Tx & Rx) of Fiber optic port or Redundant Ethernet port 100/1000 MBPS, with dual active depending on the proposed configuration

d. The Communication network shall be on PRP.

Protocols

Communication protocol IEC 61850, IEC 60870-5-103, IEC60870-5-104 (Master & Slave), MODBUS (Serial & TCP), SNMP v1, v2c and v3 and SNTP / IEEE1588 V2 with Server and

Client license shall be available. The RTU shall meet the IEC 61850 standard in every respect and interoperability with other manufactures IEDs and tools shall be verified. Master and slave license shall be provided for all the above-mentioned protocols.

41) **Algorithm and Logic**

a. The RTU shall be based on advanced and proven algorithms for writing interlock logics, so an easy and efficient upgrade of the RTU functionality shall be possible.

b. The interlock logics shall be User interface based (or) Functional block diagram based.

c. Necessary advanced logical & arithmetic functions shall be available.

d. Interlocking modules for all types of switchgear arrangements shall be available in order to avoid damaging switchgear operations and to ensure personal safety.

e. The RTU shall support interlocking via station bus and/or hardwired solutions.

f. RTU shall facilitate user defined logic functions such as automatic control sequences by means of available logic elements. For example, with one command perform a safe change of the connection of a selected line from one busbar to another busbar in double busbar switchgear.

g. Command is always to be given in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated (Select-before-execute).

h. It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers).

i. A delay/integrator shall allow the pick-up and reset of binary signals to be delayed before being displayed or used to control other functions.

42) **Self-Supervision**

a. The RTU shall have extensive self-supervision including all I/Os and communication channel.

b. The RTU shall have LEDs for healthiness / error indication

c. RTU shall have the facility to generate and download the log files for maintenance and troubleshooting.

d. Each RTU shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the equipment of the station.

e. Command execution timer (configurable) must be available for each control level point. If the control action is not completed within a specified time, the command should get cancelled (Run Time Command cancellation). The timer for this command time-out feature shall also be configurable.

f. In case of restoration of communication links, power supply after failure, the software along with hardware shall be capable of booting automatically & synchronize with the remaining system without any manual intervention.

g. It shall be possible to re-boot the BCU through the LAN/WAN from a remote location.

43) **Disturbance & Event Recording**

a. An event recorder that can handle up to 2000 time tagged events shall be included. Events shall be stored in non-volatile memory.

b. The RTU shall have an internal clock with the stability of 10 PPM or better. The RTU time shall be set from time synchronization messages received from GPS Receiver/Gateway. SOE time resolution shall be 1ms or better.

c. The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the RTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. SOE shall be transferred to Master Station through gateway as per IEC 60870-5-104 protocol.

d. It shall be possible to retrieve the recorded event on the Purchaser's SCADA system.

e. All recorded disturbance data from the RTUs shall be automatically uploaded (event triggered or once per day) to a Purchaser's SCADA Systems.

44) **Control and Monitoring**

a. The system shall incorporate the control and monitoring, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

b. Supervision of mA input signals from transducers shall be possible to include.

c. Raise and lower operation of OLTC taps of transformer, Control of protection relay systems in or out of service shall be available through RTU.

d. The operation shall depend on the conditions of other functions, such as interlocking, etc.

e. The analogue values acquired/calculated from multifunction meter shall be available to SCADA System. The abnormal values must be discarded. The analogue values shall be updated every second. The RTU shall convert the raw data from the MFM to an engineered readable value and send it to the SCADA systems. RTU shall be capable of acquiring 32 bit analog and accumulator data from Multi-function meters/Numerical relays on MODBUS/IEC60870-5-103.

f. The commands are always to be executed in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated.

45) **Power Supply**

a. Redundant Power supply module of 110 V DC /220 V DC +/- 20 % shall be available. Provision of two 110/220 V DC feeder shall be made available by the Purchaser from the DCDB. Same shall be finalized during detailed Engineering.

b. The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the RTU internal logic from being damaged and becoming unstable causing mal operation.

46) **Time Synchronization**

a. **Time synchronization interface:** The unit shall be capable to synchronize the internal RTC via communication ports on SNTP or on IEEE1588 V2 through GPS clock.

b. In absence of direct synchronization signal from GPS receiver, the RTU shall be synchronized through gateway.

c. **Timing Accuracy:** The RTU shall time-tag event reports to an absolute accuracy of ***10 µs or better***. RTU at different system locations shall have the same absolute minimum timing accuracy.

47) **Environment requirements, Reliability & Cooling**

a. The panels shall be installed in switchgear room or in relay room with no temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from 0 to +65-degree C with rate of temperature change of 20-degree C/hour and relative humidity 95%, non-condensing.

b. The Unit shall have high reliability in operation and shall not use cooling fans. The unit shall have vermin proof enclosure and shall insulate electronics, internal components and electronics from external environment in order to avoid failures due to dust, condensation, humidity, fungus etc.

48) **Expansion in future**

Extension possibilities with additional I/O's inside the RTU unit or via Fiber optic communication and process bus. The RTU shall also support sub-rack arrangement.

49) **I/O Sub Systems**

a. Hot replacement of all I/O modules.

b. A complete set of process interface

c. High disturbance immunity, meeting the requirements of the IEC directives 89/336/EEC and 73/23/EEC when placed in cabinets.

d. Comprehensive self-diagnostics

e. On-board processing capabilities such as time-tagging, event handling, filtering and gain control.

f. Shall supports transparent dual redundancy

g. Modularity, permitting step-by-step expansion

h. Reliability and auto-diagnostics

i. Easy to configure.

j. Quick fault finding with help of LEDs of each module and channel

k. support of dual redundancy in power supply

l. The relative time error between events (DI signals) handled within one controller shall be <1 ms (interrupt driven). The relative time error between events handled within separate controllers shall not be more than 2 ms.

50) **Engineering Functions**

a. A tool for user friendly engineering and disturbance handling shall be available.

b. Configuration of all input and output logical signals and binary Inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

c. It shall be possible to access the RTU remotely from the Master Station for configuration/maintenance activity. The bay control shall have multilevel passwords to safeguard bay control, logic, and automation settings.

d. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool- Laptop)

e. The configuration software should be able to configure control, protection, inputs, outputs, etc. The software should also have provision to view all the electrical parameters. Actual conditions of all inputs, outputs, protection and control elements.

f. The software should allow configuration of the IED with different versions.

g. It should be possible to configure the IED for its protocol settings.

h. For IEC 61850 protocol, the ICD file generation should be possible through software.

51) **Cyber Security**

a. Secure access- Level Wise enabling of settings with User Rights should be incorporated with Password protection in the RTU. Each User shall have his/her own User Id & Passwords.

b. User Credentials to access RTU shall be authenticated through Purchaser's Active directory Server.

c. All actions/modifications/deletions shall be logged in the RTU. These logs shall be pushed to Purchaser's Central Asset Management system/SOC.

d. It shall be possible to access the RTU through a web browser (Https Support) anywhere from the LAN for configuration, diagnosis, monitoring, file upload & download through SFTP, simulation and log retrieval by using appropriate user account management viz. Role based access control & password complexity

e. The RTU should also supports Authentication and Authorization of individual users, Security logging.

f. RTU shall be NERC-CIP/NIST 7628, IEC62351 and IEEE 1686 compliant.

g. RTU shall be enabled with System hardening viz. disabling/removal of unused ports and services.

Bidder shall provide all cybersecurity related documents and related checklist which shall be demonstrated during FAT

52) **Test Function**

a. Vendor to provide the detailed test procedure for testing the RTU functionalities using IEC61850, GOOSE messaging and protection scheme Implemented/proposed. Vendor to ensure the required hardware and software to test the above at the time of FAT and SAT.

b. The protection system shall support a test mode where it shall be possible to set or reset binary Input signals, signalling and tripping contacts individually or in groups.

c. All output relay contacts can be blocked via a setting & configuration program.

d. Using the test function, it shall be possible to set or reset signalling & tripping contacts individually.

e. A test sequencer for the local bay protection functions shall be part of the user Interface programme. Virtual current, voltage and binary signals shall be programmable In a minimum of six different sequences to verify the correct operation of the respective functions and settings in the respective bay unit.

f. It shall be possible to run these test sequences and simulations during normal operation, i.e. without affecting the station protection system in service. Re-use of saved test sequences shall be supported.

53) **Binary inputs / outputs:** Typical Input/Outputs requirement

	Digital Inputs (DI)	Digital Output (DO)	Analog Input (AI)
Misc. RTU	256	256	32

8.4 **Engineering Station (Laptop)**

Engineering LAPTOP shall be industrial grade LAPTOP system loaded with software for Gateway configuration, diagnosis, simulation, Logic development (Ladder Logic Programming) in Gateway. Also, shall be loaded with configuration and management software of RTUs, BCUs & DRCA on IEC 61850 LAN.

a. A tool for user friendly engineering and disturbance handling shall be available.

b. The Hardware & OS shall be compatible with offered SAS Software.

c. Engineering laptop shall have HDD hard disk (Minimum 500GB).Refer BOM for the configuration.

d. Configuration of all input and output logical, communication interfaces and other built-in functions and signals shall be possible both locally and remotely from the Master Station for configuration & maintenance activity.

e. Configuration application shall have multilevel passwords to safeguard control, logic, and automation settings.

f. Data collection, data modelling, configuration and parameter setting

g. Engineering of process information for automation and control centre systems

h. Engineering of process information for automation of non-bidder systems and their individual parameters.

i. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analysing the real time status of the process, program logic from the engineering station.

j. **Configuration Application**

i. SCL Tool shall be used to model the (IEDs) as stipulated in the standard IEC61850. SCL Tool shall be capable of generating the configuration files for any IEC61850 compliance IED.

ii. The main functions that the application shall perform are:

a. Read and edit any type of configuration file compliant with the defined restrictions by the schema of the SCL language.

b. Model devices from the libraries of Logical Nodes (LNs), Common Data Class (CDCs) and Common Data Attributes (CDAs) defined in the norm.

c. Generation of the modelling and SCL configuration files for devices IEC61850.

d. Capacity to manage projects with several devices, generating the files for the configured devices.

e. Visualization and edition of the components of the standard library of the norm. This can be customized with user additions or generate custom libraries for specific projects.

f. Export files of data templates (Data Type Templates) that can be reused to model new devices. This avoids the need to create all these sections in new models.

g. Compatible with IEC 61980-6 Ed:1, Ed:2, and other associated models like IEC 61850-7-410, IEC 61850-7-420

h. Create SCD / SSD / SED / ICD / IID SCL Files

i. Import & Export of SCD / SSD / SED / ICD / IID / CID SCL Files

j. Facilitate enhanced management of SCL files and its validation

k. Wizard for handling major process and work flow

- SLD Wizard: to draw and add Substation Configurations to the Project
- IED Configuration Wizard: to add and edit IED Configurations to the project
- SCD Wizard: to add external SCDs /SEDs to the Project

l. Library Support

- SLD library support for reusing substation drawings in multiple projects
- Data model library as per IEC 61850-6 Ed:1 and Ed:2
- Flexible design that enable user to create & edit data model library

8.5 **Layer 2 Industrial Grade Managed Switch**

The switch shall be of industrial grade type designed for continuous operation.

a. Switch shall have minimum 24 ports – RJ45 / Fiber ports of 100/1000 Mbps.

b. Switch shall be 19 inch rack mountable.

c. Switch shall support IEEE802 series for VLAN, RSTP, MSTP and Suitable for ring configuration etc.

d. Switch shall be IEC 61850 EMC and operating conditions for Power Substations Complaints.

e. Switch shall be IEEE 1613 Environmental Standard for Electric Power Substations complaint.

f. Switch shall Support Redundant Power supply of 110V / 220V DC

g. Switch shall have design for minimum Heat generation and high MTBF (minimum time between failure)

h. Switch shall Support Simple plug and play operation - automatic learning, negotiation, and crossover detection

i. Switch shall Support Quality of Service (802.1p) for real-time traffic

j. Switch shall Support SNTP time synchronization (client and server) & IEEE 1588 PTP V2 (Precision Time Protocol) for precise time synchronization of networks

k. Switch shall Support Industrial automation features (e.g. Modbus, Ethernet/IP and PROFINET protocols for transparent data transmission)

l. Switch shall be suitable for PRP/HSR configuration and devices.

m. Switch shall Support Management Tools like:

n. Web-based, Telnet & Command Line Interface (CLI) for quickly configuring major managed functions

o. SNMPv1/v2c/v3 for different levels of network management

i. Remote Monitoring (RMON)

ii. Rich set of diagnostics with logging and alarms

p. **LAYER 2 features**

i. The Switch should support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.

ii. The Switch should support Rapid Spanning Tree Protocol & Multiple Spanning Tree Protocol.

iii. The Switch shall have IEEE compliance for 802.1Q VLAN, 801.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol.

iv. The switch should have support for Port mirroring

v. The Switch should be able to discover the neighbouring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems or equivalent

vi. The Switch should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes

q. **Management features**

i. The Switch should support SNMP v2c, V3

ii. The Switch should support Configurable SNMP traps

iii. The Switch should support Logging to syslog with time stamp

iv. The Switch should support NTP support.

v. Full environmental monitoring of PSUs, fans, temperature and internal voltages, with SNMP traps to alert network managers in case of any failure

r. **Power supply**

i. Redundant 110V/220V DC power supply module Preferably.

ii. Power supply voltage level shall be selected during detailed engineering

s. **Environmental**

i. The switches should have IEEE 802.3az Energy efficient Ethernet and ROHS compliance

ii. Switch should be capable of operating under normal room temperature without the requirement of Air conditioning.

8.6 **Layer 3 Industrial Grade Managed Switch (Substation)**

a. **Generic Requirements**

i. The Managed Ethernet Switch should be Layer-3 and shall be 24-port with following configuration Preferably.

10/100 Mbps Copper Ports – 16nos

100/1000 Mbps Fiber Ports – 8nos

ii. It should support Active-Active Clustering, VSS or equivalent technology for high availability and quick resiliency.

b. **LAYER 2 features**

i. The Switch should support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.

ii. The Switch should support Rapid Spanning Tree Protocol & Multiple Spanning Tree Protocol.

iii. The Switch shall have IEEE compliance for 802.1Q VLAN, 801.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol.

iv. The switch should have support for Port mirroring

v. The Switch should be able to discover the neighbouring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems or equivalent

vi. The Switch should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes

c. **LAYER 3 features**

i. The Switch should support basic Routing-Static IP routing, RIP v1/v2, RIPng and policy-based routing.

ii. The Switch should support hardware enabled advance IP routing protocols OSPF, OSPFv3, BGPv4, PIMSM, PIM-DM, PIM-SSM etc.

iii. The switch should support at least 500 routing table entries.

iv. The Switch should support VRRP, LACP & Non-blocking L3 switching

d. **Virtual Switching Support**

i. The Switch should support combining of two separate physical switches in a single logical unit

ii. The Virtual switch system should be responsible for the control plane of both the switches

iii. The Virtual switch data planes of both the physical switches should be active

iv. The virtual switching links between the 2 High Available switches should be min of 10Gbps bandwidth with no single point of failure, all the required modules / other related cards should be proposed from day one.

v. The switch should support In-Service OS upgrade mechanism with a minimal disruption of traffic through upgrade process.

vi. The failover should be transparent to other networking devices

vii. It Should support configuration roll back for quick correction of wrong configurations

e. **IPv6**

i. The switch should support IPV6 in hardware without the addition of special modules to achieve that forwarding & the Switch PPS performance should not degrade for IPv6 packets

f. **Quality of Service**

i. The Switch should support Per-port -per-VLAN policies, Distributed policing (up to 4 K polices), Egress/Ingress policing, Diff Serv QoS on all ports, minimum four queues per port in hardware.

ii. The Switch should support Congestion Avoidance: WTD or WRED, multiple Queue Thresholds or equivalent technology.

iii. The Switch should support Strict-Priority Queue (protects mission-critical, delay-sensitive traffic), Weighted Round Robin (WRR), Priority queuing, Weighted Random Early Detection (WRED), Tail-drop thresholds or equivalent technology.

iv. The switch should support Traffic policing, Traffic shaping, Traffic marking and classification

v. The switch should support IEEE802.1p CoS and DSCP based traffic marking

vi. The switch should support Cross stack QoS

g. **Security** features

i. The Switch should support IEEE 802.1x

ii. The Switch should support at least 500 ACL

iii. The Switch should support VLAN ACLs, Router ACLs, port based ACLs

iv. The Switch should support TACACS+/RADIUS

v. The Switch should support Shall have SSHv1 , SSHv2, SNMPv1, SNMPv2, SNMPv3, Web Based GUI, Telnet and NTP support

vi. The Switch should support Management Access Filter (Access Policies) & Port level access-lists

vii. The Switch should support Dynamic ARP inspection

viii. The Switch should support IP Source guard

ix. The Switch should support MAC binding

x. The Switch should support Per-port storm control

xi. The Switch should support Secure admin access over SSH

xii. The Switch should support IEEE 802.1x

xiii. The Switch should support Security encryptions

xiv. The Switch should support Private VLANs

xv. The Switch should support a mechanism to prevent a malicious user from spoofing or taking over another user's IP address by creating a binding table between client's IP and MAC address, port, and VLAN

h. **Management features**

i. The Switch should support SNMP v2c, V3

ii. The Switch should support Configurable SNMP traps

iii. The Switch should support Logging to syslog with time stamp

iv. The Switch should support NTP support.

v. Full environmental monitoring of PSUs, fans, temperature and internal voltages, with SNMP traps to alert network managers in case of any failure

i. **Power supply**

i. Redundant 110V/220V DC power supply module preferably.

ii. Power supply voltage level shall be selected based on the panel it is installed

j. **Environmental**

i. The switches should have IEEE 802.3az Energy efficient Ethernet and ROHS compliance

ii. Switch should be capable of operating under normal room temperature without the requirement of Air conditioning.

8.7 **Networking Accessories**

a. **Fiber Patch cords**

Ruggedized Multimode patch cords of suitable length shall be supplied which would be compatible to the end devices and LIUs. The FO patch cords shall be ruggedized and the patch cord color shall be Orange.

b. **LIUs**

LIUs which are part of the SAS shall be rack mounted type and shall be installed in network switch panels (L2 switches) with proper cable trough arrangement as per the configuration diagram. The LIUs type for SAS shall be Multi-mode and the connectors type shall be of ST/LC type(preferably). LIUs shall include all the accessories for terminating the cable such as pigtail, splice holder, coupler etc. All cores of the fiber cable shall be terminated on the LIU. LIU shall be rodent proof.

c. **Patch Panel**

The Patch panel shall have 24Port with RJ45 Connectors (Jack field) with cable support arrangement. All structured UTP armoured cabling shall be terminated through patch panels before connects to Ethernet switch/end equipment.

d. **I/O Box**

All the structured CAT6 cabling on the device side shall be terminated on I/O boxes. The IO box shall have QUAD face plate with 4 RJ45 connectors, Back covers and mounting screws & appropriately mounted inside the panel.

e. **UTP Patch cords (CAT6)**

Prefabricated (factory crimped) CAT6 UTP Patch cords for intra panel connection/within panel from equipment to equipment.

8.8 **GPS Receiver for Process Bus & Station Bus**

a. GPS based time facility, using Universal Time Coordination (UTC) source, shall be provided for time synchronization of Sub-Station Automation System at various Receiving Stations. The time receiver shall include an offset adjustment to get the local time. It shall have propagation delay compensation to provide an overall accuracy of +/- 1.5 microseconds.

b. The GPS system shall be redundant and shall be mounted in the Gateway Panel

c. The GPS system shall have minimum eight 10/100/1000Mbps LAN interface for NTP/SNTP/IEEE1588 along with other interfaces. In addition, there shall be 2 nos. dedicated port for IEEE1588. The time receiver shall detect the loss of signal from the UTC source, which shall be suitably indicated and reported to purchaser's SCADA system. Upon loss of signal, the time facility shall revert to its internal time base. The internal time base shall have a stability of 2 PPM or better. The GPS system shall include digital displays for time and date in the format DDD:HH:MM:SS (the hour display shall be in 00 to 23 hour format) GPS system shall also be used to drive separate time, day, date and frequency indicators which shall be wall mounted type. The display for time shall be in the 24-hour, HH:MM:SS:SSS format. The display for the day & date shall be xxx format (MON through SUN) & DD:MM:YYYY, frequency XX.XXX respectively. Bidder shall provide wall mounted type digital display units for time, day, date & frequency indication. The frequency shall be derived from 230V AC supply. Each digit on the time, day and frequency indicators shall be at least 7.5 cm in height and shall be bright enough for adequate visibility in the control room from a distance of 15 meters. The offered GPS clock shall also provide at least one 2 MHz (75 ohm interface confirming to ITU-T G.703) synchronization interface to meet the time synchronization requirement of the communication system. This interface shall confirm to the requirements specified in ITU-T G.811 for accuracy, jitter, wander etc.

d. Technical requirements: The system shall include GPS antenna, GPS receiver, signal processing unit, comparator, signal conditioning units, power supplies, lighting arrestor with batteries, standard antenna cable with additional 50m length, etc. The frequency & Time display Units shall be wall mounted in the control room. Bidder to indicate the battery back-up time provided.

e. GPS should support multiple LAN network topology with multiple SNTP ports viz. separate LAN /SNTP ports supporting different IP networks

f. The system shall provide time synchronizing signals in the following formats

i. RS 232 / 485

ii. IRIG-B (AM 1 KHz SIGNAL)

iii. IEEE 1588 V2, NTP, SNTP

g. Any single failure shall not lead to loss of partial/full functionality.

h. The system shall be based on Global Positioning System (GPS) reference.

i. The System shall receive the synchronizing signals from remote satellite and after suitable conversions and conditioning shall provide time signals for synchronization of RTU, BCU, BCPUs, Numerical Relays, DRCA and Fault Disturbance Recorder systems.

j. Electronic earthing for the supplied system to the nearest grounding box/earth pit shall be included in the scope.

k. The Master Clock shall be configured as Real Time Clock with display of time in 24 hrs format and date and shall drive slave clocks.

l. All cabling between the Bidder supplied equipment shall be in Bidder scope.

m. Any Servers (e.g. NTP/SNTP server) shall be included in the scope

n. Bidder shall offer time synchronization using Serial and IP based ports.

o. The system shall be suitable for continuous operation under the specified site conditions.

p. The master clock shall have the facility to be programmed from a Web-interface that can be accessed through any typical web browser such as Microsoft Internet explorer.

q. Technical features of the Master Clock System shall be as follows:

r. **GPS Receiver**

- Type : Redundant Microcontroller based where applicable
- Tracking : GPS-L1, C/A code, 12 channels, accuracy < 1 microsecond
- Redundant : Fully redundant
- Output : Minimum 4 nos. Fiber optic independent SNTP outputs for Station Bus, Minimum 4 nos. Fiber optic independent IEEE1588 V2 i.e.,PTP outputs for Process Bus, Serial & Potential free Contacts (1PPS, 1PPM, 1PPH), ports and contacts as per BOM
- Operating Temp : 0 to 50 Deg C, (-30 to +80 Deg C for GPS Antenna)
- Display : Backlit LCD, Functions – showing local date & time, Position – latitude, longitude, altitude, Receiver & Clock status, deviation & Event time.
- Time format : 24 hours format
- Time Reference : Oven Controlled Crystal Oscillator with stability of 1PPM
- Front Keypad : For Configuration and status monitoring
- Mounting : Standard 19” Rack mountable
- Alarm : Potential free contacts and displays for system failure / Loss of GPS signal & Synchronization to RTU through Potential free contacts.
- Back up signals : On loss of GPS signal, GPS receiver shall continue to send out time synchronization pulses based on own clock

- Signal conditioner : Suitable for all type of protocols specified.
- Power Supplies : Redundant 110V DC /220V DC Power Supply
- Amplifier : To be included as required
- Surge Protection : Mandatory.

s. **GPS Antenna**

- Type : Redundant Helical
- Noise : Less than 1 dB
- Tracking method : Code / Carrier tracking
- Output data : NEMA 0183 format
- Output rate : Continuous
- Mounting : Fixed Outdoor (sky view), wall / floor mounted,
- Lightening Arrestor : Required
- Antenna Cable : Low loss cable, length as per site requirement (min 50 mtrs)
- Weather Condition : All Seasons

t. **Slave Clocks**

- Display : Time, Day & Date Display: HOUR, MINUTE & SECONDS in 24 Hrs format & DATE, MONTH, YEAR
  : Frequency: XX.XXX Hz format
- Display size : 100 mm 7 segment Red LED
- Input : Ethernet/RS 485 from Comparator unit Clock
- Power Supply : 90-260 V AC/DC
- Interface with : Ethernet / Multi Core copper cable (Multi Drop System)

u. **GPS Receiver**

- Slave Updation : Every second
- Environment : a) Temperature: 0-50 Deg C
  b) RH: 0-90% non-condensing
- Mounting : Wall Mountable

v. **Condition Monitoring from SCADA**

- Potential Free Contact (Alarm Contact) for SCADA Monitoring
- Should Support SNMP V1,V2,V3 for Gateway Integration.
- Loss of Time Sychronization alarm shall be sent as a hardwired alarm to RTU

8.9 Panel and other Accessories

a. All Automation Panels shall be front Swing / front fixed type and rear side shall be double door. All the panels shall be of IP54 class and industrial grade.

b. Bidder shall submit the GA drawing considering the clearance between the equipment, easy access and removal during failure/repair, maintenance and aesthetic requirements and submit the drawings along with bill of material for purchaser's review.

c. Panel shall have Louvers (min.2nos) & Fan (Min.2nos) arrangement for ventilation. Bidder shall guarantee the satisfactory functioning of the system hardware mounted in the panels even in the event of failure of air-conditioning.

d. Proper size Cable trough (Width, length) shall be provided in the panel after reviewing the number of cables to be terminated in the panel.

e. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trough.

f. Control panel shall be suitable for bottom cable entry.

g. Interconnection between panels shall be by prefabricated cables with proper conduit.

h. All Source terminal blocks shall be droppable (or equivalent) and the terminals shall be distributed functionally in the panel.

i. Panel door locks shall have the common key.

j. Acrylic glass sheet shall be provided, wherever the power cables & terminations are exposed and prone to be fatal.

k. Electrostatic strap shall be fitted with each panel.

l. **Sheet Metal Work**

The panel frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.5 mm.

Frames shall be enclosed by cold rolled sheet steel of thickness not less than 2 mm, smoothly finished, levelled and free from flaws. Stiffeners shall be provided wherever necessary. The Panels shall be provided with MS Base Channel of 75 x 50 mm

All panel edges and door edges shall be reinforced against distortion by rolling, bidding or by the addition of welded reinforcement member.

Cut-Outs shall be true in shape and devoid of sharp edges.

The complete structure shall be rigid, self- supporting, free from vibration, twists and bends.

m. Constructional Features

SAS cabinet shall be indoor type, floor mounted, with total dimension (2315 (H) x 800 (W) x 800 (D)) and front swing frame or front fixed and rear double door . Front glass door with 19" rack arrangement.

The panel dimension shall be 2200 (H)x800(W)x800mm(D),100 mm(H) plinth and Anti-vibration pad of 15 mm (H) thickness should be provided.

The panel shall be -

i. Of the metal enclosed indoor, floor mounted.
   - Preferred make of Automation Panels – Rittal make

ii. Made up of the requisite vertical sections.

iii. dust, moisture and vermin proof construction

iv. It shall have lifting i-bolts for hooks of good capacity and even distributed lifting. Test certificates shall be available for the lifting bolts.

v. Suitable to provide a degree of protection of not less than IP 54 as per IS: 2147.

vi. It is the responsibility of the bidder to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the SAS design shall be properly accommodated in the panel, in such a way that the maintenance, identification, isolation of any component or circuit shall be easy. Equipment shall be mounted such that removal and replacement can be carried out individually without affecting the services of the adjacent devices. No price increase at a later date on this account shall be allowed.

vii. Of self-cooled design with adequate louvers on sides. The louvers shall have screens and filters on inner side of panel. The screens shall be of fine wire mesh made of brass or GI wire.

viii. Provided with labels on the front and rear indicating the panel designation.

ix. Proper provision has to be provided for the entry of FO cables and Ethernet cables at the bottom. AC & DC incoming cable entry provision should also be there.

x. Provided with pocket on rear door for keeping A4 size copy of panel drawings.

xi. Provided with 4 nos. of lifting hooks.

xii. Provided with neoprene gaskets all-round the perimeter of covers, gland plates, removable covers and doors.

xiii. 150 sq.mm copper earth bar has to be provided for equipment earthing.

xiv. All sheet steel work shall be degreased, pickled, phosphated and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside. The paint shade shall be Siemens Grey (RAL 7032). The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns.

xv. For every distribution of AC and DC circuits MCB’s has to be provided. These MCB’s has to be rated according to the load on the distributed circuit.

xvi. Each RTU/Gateway, Switch panels shall be provided with 20% spare terminals.

xvii. If I/O interface boards are used for field input connection proper isolation facility shall be provided. Preferably disconnecting type of terminal blocks shall be used for all inputs.

xviii. Interconnection between panels shall be by prefabricated cables.

xix. Terminal blocks shall be having provision for isolation, with full-depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Required number of TBs shall be provided for common shield termination for each cable.

xx. All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made up of flame retardant material and shall not produce toxic gasses under fire conditions

xxi. Proper lighting arrangement shall be made on both sides of the panel if both sides of the panels are used.

xxii. Space heater with thermostat shall be provided in the panel to maintain the required temperature & should be mounted suitably so as to not interfere with power & control cables entering the panels.

xxiii. Disconnecting type terminal blocks shall be used for AC & DC sources and for all Digital Outputs from relay coil for SCADA command.

xxiv. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trough.

xxv. Terminals shall be distributed functionally in the panel.

xxvi. The panel shall also have a document pocket.

xxvii. Horizontal and vertical Grounding bus shall be provided in the panel. Green coloured wires shall be used for grounding purpose. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the Panel/Station through a flexible braided copper conductor rigidly.

n. Cabinet Internal Wiring

SAS cabinet shall be wired with all the DC distribution wiring and AC wiring for the Illumination and fans. Following sizes of wires shall be

Colour Codes

DC wiring	**1.5 sq.mm**	**Red/ Black/Grey**
AC wiring	**1.5 sq.mm**	**Blue/Yellow**

Engraved identification ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. These ferrules shall fit tightly on the wires, and should not fall off

when the wire is removed. The wires should be terminated on terminal blocks using soldering crimping type of tinned copper lugs. Insulated sleeves shall be neatly punched and cleaned without affecting access to equipment mounted within the cabinet. Wiring troughs shall be provided for cable routing inside the cabinet. One piece moulded, 650 V grade terminal blocks complete with insulated barriers, screws, identification strips shall be used. Terminals links shall be of Elmex or Connect well make. Terminals for power connections shall be adequately rated for the circuit current and the rating of other terminal blocks for central indication etc. shall not be less than 15 amps. At least twenty percent spare terminal blocks shall be provided. All the terminal blocks should be provided with proper identification strips. Terminal blocks shall be provided with transparent acrylic covers.

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Cable ways & troughs shall be used for this purpose.

Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.

o. Labels

All equipment's shall be provided with individual labels with equipment designation engraved. Also the control cabinet shall be provided on the front with a label engraved with designation of the cabinet as furnished by PURCHASER. Labels shall be made up of non-rusting metal or 3 ply lamicoid. Labels shall have white letters on black or dark blue background. Sizes of labels and lettering are subject to PURCHASER's approval.

Manufacturer's label should be provided at the rear door, which should mention the project ref, substation, P.O ref, circuit details, drawing ref.

p. Earthing Terminals

Control cabinet shall be provided with two separate earthing terminals suitable to receive PURCHASER's earthing conductors of size specified.

Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wire/bars bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All equipment shall be connected to the earth busbar using 1100/650V grade PVC insulated 2.5 sq.mm stranded tinned copper earthing conductor.

All hinged doors shall be positively connected to the earthing bus terminals, with the help of braided copper conductors of adequate size.

An electrostatic discharge arrangement shall be provided in each panel so as to discharge human body before he handles the equipment inside the panels.

8.10 **Multifunction Meter**

110kV Bays :

Bidder to consider Multifunction meter for each bay, which shall be mounted on the LCP panel of 110 KV GIS Bay or in the Protection Panel for AIS bay. These meters shall be integrated to respective BCUs/Gateway on Modbus RTU. Separate MFM shall be considered for all Bus PTs (Bus Voltages) other the MFM of the Bus coupler & Bus-Section Bays.

Auxiliary Systems:

MFM mounted in 415v Switchgears, ACDB, DCDB, UPS, Fire protection & detections system shall be looped in daisy chain and shall be integrated with Misc./Gateway.

Single RS-485 daisy chain loop shall not exceed more than 10 MFM Meters.

DATA SHEETS – SUB-STATION AUTOMATION

Refer annexure E2- 3B Automation Technical Requirement of Automation

- Bay Control Unit (BCU)
- Switchgear Control Unit (SCU) – Process Bus
- Remote terminal Unit (RTU)
- Layer-2 Switch
- Layer-3 Switch (SAS)
- GPS – Both Process Bus & Station Bus
- MFM
- Engineering Station (Laptop)

9.0 QUALITY REQUIREMENTS, INSPECTION, TESTING

9.1 Quality Assurance

To ensure that a well-engineered and contractually compliant system is produced, vendor shall adhere to a quality assurance program for the preparation of all contract deliverables, which includes hardware, software and documentation. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of tracking all such deficiencies. Bidder shall submit the following information along with the Technical Bid and project specific document after award of contract. Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

9.2 Factory Acceptance Test (FAT)

The Vendor shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the Substation Automation System along with Process Bus based digital Substation bays for approval. For the individual bay level, and the respective Protection system type test certificates shall be submitted. The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT).The purpose is to ensure that the Vendor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. During FAT the entire System including complete control and protection system to be supplied under present scope shall be tested for complete functionality and configuration in factory itself. The extensive testing shall be carried out during FAT. The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. No major configuration setting of system is envisaged at site.

9.3 Integrated Testing

The integrated system tests include Protection & automation shall be performed as detailed in subsequent clauses as per following configuration:

SCU, MU, BCU, Protection IEDs, Gateway, Protection cum Miscellaneous RTU, GPS, DRCA with complete Communication system as per the approved architecture under this RFP for the integrated FAT.

All other components for complete sub-station as detailed in section project shall be simulated as needed.

Bidder to submit a detailed integrated FAT document with checklist covers various tests/checks performing during the inspection for TATA Power approval.

Bidder shall demonstrate the complete Network Performance test during FAT

9.4 Hardware Integration Tests

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

9.5 **Integrated System Tests**

Integrated system tests shall verify the stability of the hardware and the software of Protection, Automation and Communication System including MUs & SCUs which are related to Process Bus base digital Substation. The Integrated FAT will be performed as per the approved drawings, documents, Procedures, configurations and relays settings etc., During the tests all functions shall run concurrently, and all equipment shall operate properly. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

If the complete system consists of parts from various suppliers or some parts are already installed at site, the FAT shall be limited to sub-system tests. In such a case, the Vendor can use their SCADA System for testing the functionality as per the Users requirement. Otherwise the complete system test shall be performed on site together with the site acceptance test (SAT).

i. Prior to release for shipment of the equipment the Purchaser or his representative shall witness Factory Acceptance Test (FAT) in which the system is checked against the specifications.

ii. The FAT shall include testing of all the hardware and software modules of Process Bus based Digital Substation.

iii. Spare modules and spare channels also shall be tested in FAT.

iv. Bidder shall indicate all the simulation facilities that shall be used in FAT.

v. Vendor shall submit FAT procedure 2 weeks before commencement of FAT for purchaser's approval.

vi. Vendor shall incorporate all FAT comments prior to despatch. After Vendor confirms that all changes have been incorporated, Purchaser's Office shall issue Despatch Clearance.

vii. The Test Reports as well as Test Certificates of OEM, third party, Vendor shall be submitted for approval / verification.

viii. Tests shall include demonstration of System Responses (GOOSE testing) and Loading (CPU, Memory & Communication Bus) including worst-case scenario and expandability of the system.

ix. SV,GOOSE and MMS Inter-operability between Multi-vendors IEDs and Integration with SCADA

x. FAT and Despatch Clearance by the Purchaser shall not relieve the Vendor from complete responsibility for the total system and its performance subsequently.

xi. Redundancy, Backup & Restoration functions shall be tested.

xii. Proposed Communication Network Redundancy in terms of reliability and availability

xiii. Complete Network performance test as per approved architecture.

xiv. Engineering, System configuration and Diagnostic tools shall be demonstrated.

xv. The system shall be kept ON continuously without interruptions for at least 72 hours during the FAT.

xvi. Tests requiring advanced Laboratory facilities that may not be available at site shall be conducted during FAT.

xvii. Travel, Boarding & Lodging expenses for the Purchaser's representatives for FAT shall be borne by the Purchaser, Local transport for Purchaser's representatives from the place of stay to Vendor's works shall be arranged by the vendor. Vendor shall make available all necessary documentation & office facilities for Purchaser's representatives. Specialists of sub-vendors shall be present for FAT. Training at Vendor's Works shall precede FAT and shall include troubleshooting and advanced testing techniques.

xviii. Deficiency Reporting

- In case of failures, deficiency reports shall be written for hardware, software, functional performance & documentation deficiencies. The deficiency reporting procedure includes methods to ensure that deficiencies are identified, documented & corrected. The documentation shall include a unique identifier for tracking as well as a detailed description of the deficiency. A deficiency status summary shall be included from time to time in the project progress reports, & up to date deficiency reports shall be made available to the purchaser on demand.
- When a test fails, a separate deficiency report shall be written for each problem that prevented the successful completion of the test. Deficiencies shall be classified by their severity as follows:

  i. Fatal - Priority A
  ii. Major - Priority B
  iii. Minor - Priority C
  iv. Documentation - Priority D

- The presence of fatal discrepancies, such as the complete failure of the system, shall be acted upon immediately and may, at the discretion of the purchaser, be cause for suspension of the tests. A retest shall be agreed which may include all or part of the test procedures. All other discrepancies shall be corrected and re-tested without suspending the entire test. The

purchaser shall have the right to request that other hardware and software modules that may be impacted by the correction be re-tested.

9.6 **Commissioning**

i. The commissioning of the system (hardware and software) including Site Acceptance Test and one month Trouble-free Operation shall be the responsibility of vendor. Development and customization of all software components shall be in Bidder's scope.

ii. Adequate number of competent engineers esp. OEM engineers (Hardware & Software) as approved by Purchaser shall be posted at site during the entire period of installation & commissioning. In addition telecom specialists shall be deputed to site for establishing communication systems.

iii. Daily site work shall be planned and executed as per due approvals from Purchaser's representative.

iv. Vendor shall submit detailed site organization chart of Personnel for Purchaser's approval. Purchaser reserves the right to review the same. Vendor's commissioning engineers shall also train purchaser's engineers during commissioning apart from scheduled Training.

v. The responsibility for Installation, Commissioning, Performance Guarantee and Warranty shall remain with the vendor.

vi. The vendor shall furnish procedures, protocols and time schedules for commissioning and Acceptance Test activities.

vii. All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of bidder.

viii. All passwords, access keys etc. are the property of the Purchaser and shall be handed over to the Purchaser.

ix. All Inter-Operability Tables for interfacing to other systems shall be supplied.

x. Principal's representatives including specialists shall participate at site for supervision & certification of commissioning and Acceptance Tests.

9.7 **Site Acceptance Test (SAT)**

i. SAT shall cover all equipment and functions as specified for the complete system (all hardware & software) and connectivity with Purchaser's system. As such SAT shall cover all the tests listed in FAT along with site-specific tests including interconnections with field equipment and other systems. Apart from testing and commissioning, SAT shall include one month of continuous trouble-free operation of the complete system without major intervention. In case of interruptions, one month trial shall be restarted after attending to the problem.

ii. IEDs used for protection, control, etc.; the redundant inter-bay bus (and associated communications hardware/software), the redundant station bus (and associated communications hardware/software), the time synchronization system (redundant GPS receivers) and the local/station HMI are to be considered as SAS components, and shall undergo commissioning requirements as part of the SAT.

iii. Vendor shall furnish, advance SAT protocols and list of vendor's instruments for site testing. Tests shall include demonstration of loading & expandability of the system.

iv. SAT shall be performed after the system has been installed, the final software has been loaded in each subsystem, all I/Os and functionality checked, system has been running and all commissioning checks have been completed successfully.

v. Unstructured tests shall be employed as necessary, to verify overall system operation under field conditions.

9.8 **Test Procedures**

Test Procedures (for FAT, Commissioning and SAT) shall be prepared by the vendor to test the specified functional and performance requirements of the system which shall include but not be limited to the following:

a. System Hardware Tests

- **Visual Test:**

  Verification that the system includes all required equipment and is properly configured. This includes a visual inspection for proper workmanship and labelling, including cables and connectors.

- Verification of Upgrade and Expansion Capabilities:

  Inspection and verification, to the extent possible, that provision to upgrade and expand the system are furnished as required by the contract.

- **Hardware Diagnostic Test:**

  The hardware diagnostic test consists of individual test of all system hardware. These tests consist of running standard hardware diagnostic programs, plus special diagnostic programs used by vendor where appropriate.

b. System Functional Tests

The purpose of the system functional tests is to rigorously exercise all functions and to verify the correct functional operation of all hardware and software. The system functional tests shall include, but not be limited to, the following tests. The Purchaser shall also be able to perform other tests not specifically mentioned.

- Verification of proper data acquisition & control from the Process Bus device, BCUs, RTUs and Gateway.

- Verification of proper data acquisition from the Energy Meters & BCUs
- Verification of proper data acquisition & control from Purchaser's external systems.
- Verification of proper data acquisition & control from third party systems.
- Verification of the proper response of the system to include
  - Loss / Restoration of signals /data Process Bus device, BCUs, RTUs and Gateway.
  - Loss / Restoration of Input Power
  - Loss / Restoration of Communication System
  - Loss/ Restoration of Time synchronization
- Verification of System Redundancy including fail-over procedures and restart.
- Verification of all development and maintenance capabilities Including:
- Response measurement at Process bus & Station Bus level as per Standard Procedure
- Communication response at Process Bus & Station Bus level as per Standard Procedure
- GOOSE Testing & Response as per Standard Procedure
- Database Generation and Maintenance
- Back-up and Restoration functions of all systems.

System Performance Tests

The system performance tests shall verify that the performance requirements are met for the system as specified in the purchaser's technical specification. For example, performance testing shall include the verification of data acquisition performance etc.

9.9 **System Availability Test**

To ensure that the system software is error-free and that the hardware system is reliable, thirty (30) days continuous run of the system shall be performed after the successful completion of system functional tests and system performance tests. The system configuration shall be as per the final system configuration.

This test shall be considered successful if no critical function is lost and no hardware or software failure occurs within a consecutive 30 days period. Any minor or major hardware deficiencies shall be removed prior to starting the test.

During this test, the system shall be exercised a manner, which approximates an operational environment. No software patches, modifications, or changes shall be allowed to bypass failed modules during this test. If a module affecting a critical function fails. the failed module shall be replaced, and portions of the system functional tests affected by the change shall be repeated and the system availability test shall be re-run in totality.

10.0 PERFORMANCE REQUIREMENTS

10.1 **System Performance Standards**

The system shall meet performance as per the IEC & IS standards required to maintain real-time monitoring and control of the network.

10.2 **System Response**

The system shall meet the following response and resource utilization requirements:

a. The system functions and associated databases shall be capable of accommodating at least a 50% increase in the delivered capacity without requiring regeneration, recompilation, or any processing other than definition of the database by Tata Power.

b. Process Bus data shall be reported to station bus device with a resolution of <1 msec.

c. All Digital Inputs shall be reported with a resolution of 1 msec.

d. All Digital Inputs shall have individual channel reporting

e. The system shall report correct Time Stamping when all process inputs scanning & processing is in progress & all the data is transmitted over Data Bus every sec.

f. The worst loading condition shall include the following tasks:

- All processor inputs scanning and processing is in progress and all the data is transmitted over the main data bus every sec.

- All controls in operation.
- Control / information request is initiated from all terminals.

10.3 **System Utilization**

Name	Utilization	Comments
Main Memory	30% 50%	Normal Loading Peak Loading
Processor Utilization Application processor Communication processor	 30% 50% 30% 50%	 Normal Loading Peak Loading Normal Loading Peak Loading
Local Area Networks	40% 60%	Normal Loading Peak Loading

11.0 SPARES AND SPECIAL TOOLS AND TACKLES

The spares supplied shall be strictly interchangeable with parts for which they are intended for replacement.

The spares shall be treated and packed for long storage (minimum 5 years) under the climatic conditions prevailing at the site.

The start-up spares shall be delivered at the site well in time before the start-up and commissioning of the plant.

11.1 **Start-Up Spares**

The start-up spares are those spares which will be required during start-up and commissioning of the equipment/systems, and until Final Take Over. It is the responsibility of the bidder to supply all the necessary spares as required until the equipment/systems are handed over to the Owner. An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, performance testing and handing over the equipment/systems to the Owner will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over the sub-station shall remain the property of the Owner. The Bidder shall furnish the Schedule of Start-up Spares.

11.2 **Mandatory Spares**

Essential spares are those considered necessary by the owner for first three (5) years of normal sub-station operation. A list of such spares has been listed in the below mentioned table and the same shall be included in bidder's scope. When a particular item of spares is indicated as `percentage', it shall be considered as percentage of total number of that item

of spares in the single equipment/system, unless specified otherwise and the fraction shall be rounded-off to the next higher whole number. Whenever the item of spares has been indicated as `set' the same shall mean the supply for a single equipment/system. One set of spares for the particular equipment shall mean the total quantities of that particular spares for a single equipment e.g., `set' of Server, set of Gateway, shall include HMI, keyboard, mouse etc. The `set' shall however include all components required to replace that item of spares. The Owner reserves the right to buy any of the essential spare parts as considered necessary.

In case during start-up and commissioning certain essential spares are used up, the same shall be replaced within one (1) month without any commercial implications.

Bidder shall furnish details for all essential spares as per the approved vendor document list.

Bidder to consider following mandatory spares in the offer.

SL. No.	System	Qty. (Nos./Set)
1	SCU each Type & Configuration	1no.
2	BCU with complete configuration	1 Set
3	RTU (Typical Cards of Communication cards, FIM Boards ,PSU, I/O cards)	1 Set
4	GPS Receiver with PTP & SNTP ports (same as offered in the BOM)	1 Set
5	Managed L2 Switch (Each type)	1 no.
6	Omron relays	4 nos
7	DC-DC Converter	1 nos.
8	Diode OR-ing Unit	1 nos.
9	Fiber Multi-mode Patch Cords Duplex (10 metres)	5 nos.
10	Fiber Multi-mode Patch Cords Duplex (15 metres)	5 nos.
11	CAT6 Patch Cords (2 meters)	5 nos.
12	CAT6 Patch Cords (5 meters)	5 nos.
13	IPC Machine along with OS- Advantech 610H or above	1 Set

Table-3

11.3 **Recommended Spares**

In addition to the spares mentioned above, the Bidder shall also furnish in his bid a list of recommended spares with unit prices. The Owner reserves the right to buy any of the recommended spare parts as considered necessary by him. The prices of recommended

spares shall be consistent with those of start-up/essential spares. Purchase of these spare parts will be covered by a separate order or an amendment to the contract.

The Bidder shall provide a list of recommended spares for a period of five years from the date of handover of the project to Owner. The shelf-life of these spares is such as to last for at least 7 years from the date of handover of the project.

The Bidder shall provide the MTBF of various components, sub-assemblies, assemblies etc. (recommended as spares) and the relationship between MTBF and spare quantities recommended.

The Bidder shall submit the product life cycle details of the all hardware offered under this RFP.

The table above indicate the minimum requirement of the owner, bidder to include the spares, which are not part of this table, but required for maintenance and upkeep of the system

11.4 Special Tools & Tackles

Bidder to consider and supply special tools and tackles required for erection, commissioning and maintenance of the offered system. After commissioning of the system all tools and tackles shall be handed over to Owner's Project/Maintenance team.

All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of bidder.

All configuration cables and other specialized testing passive devices to be provided with the supply of material.

12.0 DATA SUBMISSION BY BIDDER

Following Documents must be submitted along with the bid.

Bids are liable to be rejected if following minimum documents are not submitted along with the bid.

a. Deviation if any from specification strictly following the prescribed format.

b. Compliance to the approved vendor list

c. List of major relevant experiences of the Principal, Collaborator and the Product respectively.

d. Technical support facilities including qualified man-power, testing tools and instruments and integration facilities available within India.

e. Technical data sheet of critical equipment

f. System architecture drawing.

g. Compliance to data sheets covered in the specification.

h. Product life cycle document for all supplied equipment.

i. Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP)

j. Type test certificates of the offered equipment

k. Confirmation on lifetime, spares, manufacturing, onsite & Offsite technical support of the supplied equipment for the period of 15 years.

l. The Bidder shall furnish the following drawings/documents during detailed engineering within 2 month from date of PO Placement Bidder to submit all datasheets, detailed GTP of the proposed BOM items during detailed engineering for the approval and finalization by Owner.

m. System Architecture Drawing. This drawing should show in detail of the following:

   i. Network connections

   ii. Protocol used

   iii. Type of interconnecting cable

   iv. All IED's, workstations, gateways, network switches, meters etc. which are part of the SAS.

n. Panel GA and Complete wiring diagram

o. Functional Design Specification document

p. Testing Procedure Document

q. Step by Step test procedures for Factory Acceptance Test (FAT) and Site Acceptance Test (SAT)

r. SCADA I/O List with protocol details along with addresses

s. Interconnection Schedule (ICS) for Automation

t. Hardware, Software and Application manuals for all the equipment supplied including that of Third parties.

u. All Software Licenses (both own & third party), key for Hardware Locks

v. All interoperability tables

w. Guaranteed technical parameters & Guaranteed availability and reliability

x. Load Calculation for the PAC equipment.

y. Bill of Material listing equipment designation, make, type ratings, etc. of all the equipment's supplied

z. Logic Diagram (Hardware & Software)

aa. Operator's Manual

bb. Complete documentation of implemented protocols between various elements

cc. IP addressing chart for all the IED's, Gateways, Workstations, network switches which are connected to the network

dd. Diagnostic and performance evaluation software and hardware tools

ee. Details of software (Operating systems, application software, engineering tools, communication systems management software, license details, I/O distribution protocol-wise etc.) for SAS computer equipment (including PCs, Station HMI equipment and configuration laptop computers) and loadable in CD/DVD ROM

ff. All SAS related drawings in both AutoCAD & Pdf format only. However, the pdf versions of above drawings shall be submitted through wrench for formal approval process. All AutoCAD drawings of the entire project shall be submitted through Secondary Media viz. USB Storage disk.

gg. Bidder shall agree to comply with minimum quality requirements and Contractor Safety Code of Conduct, defined in bid documents.

hh. Other documents as may be required / applicable during detailed engineering

ii. All drawings and data shall be annotated in English.

jj. Bidder shall furnish six (6) hardcopies and 3 soft copies on reliable media of all drawings, manuals (Administration, Operation & Maintenance, Troubleshooting and Installation), Technical catalogues, Test Certificates and Acceptance Test Reports.

kk. Two copies of the internal test report, FAT and SAT documents with test protocol formats shall be submitted for approval at least 4 weeks before Factory Acceptance Test. Two copies of SAT protocol shall be submitted for approval at least two weeks before Site Acceptance Test.

ll. Bidder shall also furnish Original plus one copy of all System Software (OS, Application and tools) along with delivery. Bidder shall submit two copies of all the configuration, application, display, database backup of all equipment on reliable secondary media.

13.0 ANNEXURES

Annexure 1

List of preferred vendor list

Sl. No.	Item Description	Preferred Make / Model
1	Bay Control Unit (BCU) / Remote Terminal Unit (RTU)	ABB/Siemens/GE T&D
2	Gateway	ABB/Siemens/GE T&D
3	Disturbance Record Collector & Analysis System (DRCA)	Make: Kalkitech Model: Sync 3000
3	Layer 2 & Layer 3 Ethernet Switch	Ruggedcom / Hirschman / MOXA
4	Firewall	Juniper/Cisco/Checkpoint/Palo Alto
5	LIU (Fiber Optic)	Raychem / AFS / 3M
6	I/O Boxes	Systimax / Tyco / CommScope
7	Armored UTP CAT6 Cable	Systimax / Tyco / CommScope
8	Armored Fiber Optic Cable	Finolex / KEC / Apar
9	Unarmored UTP Cable	Systimax / Tyco / CommScope
10	Patch Panel (RJ45) with Connectors, I/O boxes	Systimax / Tyco / CommScope
11	Fiber Optic Patch Chords	Raychem / Preston / Tyco
12	CAT6 UTP Patch Chords	Systimax / Tyco / CommScope
13	4P X 0.36 Sq.mm. Armored Communication Cable (Multistrand, individual pair and overall shielded)	BELDEN / LAPP / SATYAM
14	4P X 0.36 Sq.mm. Unarmoured Communication Cable (Multistrand, individual pair and overall shielded)	BELDEN / LAPP / SATYAM
15	Fiber Optic Transceiver	CTC union / MRO TEK / Allied Telesis / MOXA
16	GPS Clock with remote display unit	Sertel / Masibus / SANDS/Meinberg
17	Panel make for Gateway / DRCA/RTU/Network (SAS)	Rittal
18	Layer -3 Stack Switch panel (Communication)	Valrack
19	RS 232 / RS 485 converter	MOXA / Advantech
20	DC-DC Converter	Cossel / Phoenix / Paramount
21	Diode-Oring Unit	Paramount / Phoenix
22	Droppable type Terminal Block for Digital	Connectwell – CBT4U or equivalent

	Output, CT & PT.	
23	Disconnecting type (Knife edge) Terminal Block for Digital Input	Connectwell - CKT4U or equivalent
24	Auxiliary Relays – BCU Breaker Isolator & other Digital Inputs	Make – OMRON MM4XP-D MM2XP-D
25	Auxiliary Relays - Miscellaneous RTU	OMRON
26	Multifunction Meter	Make – SATEC Model – PM130EH+
27	Rack Mounted Sliding monitor with keyboard & Touch pad.	Make – ATEN
28	Voltage Transducers	Make – RISHABH
29	Modbus TCP/IP converter	Moxa, Advantech
30	Configuration Laptop	HP/DELL/Lenovo
31	Temperature & Humidity Sensor	Make & Model : KIMO & C-310

ANNEXURE – II

Indicative Bill of Material- Sub-Station Automation
(Bidder shall refer the equipment technical specification for more details and offer the solutions accordingly)

Refer the attached Indicative BOM

ANNEXURE III

SCADA IO list for reference

Protection signals:

Signal Description	SIGNAL TYPE	STATE TABLE	
		STATE 01	STATE 10
LINE			
DIGITAL INPUTS (On Soft)			
DIFF. A-PH START	SPI	START	RESET
DIFF. B-PH START	SPI	START	RESET
DIFF. C-PH START	SPI	START	RESET
LINE DIFF. PROTN OPTD (1PH)	SPI	RESET	OPTD
LINE DIFF. PROTN OPTD (3PH)	SPI	RESET	OPTD
LINE DIFF.87L OUT	SPI	NORMAL	OUT
LINE DIFFERNTIAL COMMUNICATION CHANNEL	IGEN	HEALTHY	FAIL
CARRIER RECEIVE	SPI	RESET	OPTD
CARRIER SEND	SPI	RESET	OPTD
A/R START	SPI	RESET	OPTD
A/R OPTD	IGEN	RESET	OPTD
A/R BLOCK OPTD.	IGEN	RESET	OPTD
A/R IN	DPI	IN	BLOCK
A/R BLOCK SEL	DPI	IN	BLOCK
CARRIER FAIL	SPI	HEALTHY	FAIL
CARRIER OUT	SPI	NORMAL	OUT
DT RECEIVE	SPI	RESET	OPTD
DT SEND	SPI	RESET	OPTD
DIS. A-PH START	SPI	START	RESET
DIS. B-PH START	SPI	START	RESET
DIS. C-PH START	SPI	START	RESET
DIS. RELAY ZONE-1	IGEN	RESET	OPTD
DIS. RELAY ZONE-2	IGEN	RESET	OPTD
DIS. RELAY ZONE-3	IGEN	RESET	OPTD
DIS. RELAY ZONE(AIDED TRIP)	IGEN	RESET	OPTD
DIST. PROTN OPTD (1PH)	SPI	RESET	OPTD
DIST. PROTN OPTD (3PH)	SPI	RESET	OPTD
SOTF PROTN. OPTD.	IGEN	RESET	OPTD
POWER SWING OPTD.	SPI	RESET	OPTD
FUSE FAIL OPTD.	SPI	RESET	OPTD
LBB IN SELECTION	SPI	NORMAL	OUT
LBB INITIATION	SPI	RESET	OPTD
LBB PROTN OPTD.	SPI	RESET	OPTD
MAIN-1 PT MCB HEALTHY	SPI	HEALTHY	FAIL
LINE NO VOLT	SPI	RESET	OPTD
GR-A SETTING	SCO	ACTIVATE	NIL

GR-B SETTING	SCO	ACTIVATE	NIL
GR-C SETTING	SCO	ACTIVATE	NIL
GR-D SETTING	SCO	ACTIVATE	NIL
SPARE			
SPARE			
SPARE			
SPARE			
OLTS IN	SPI	NORMAL	OUT
OLTS ALARM	IGEN	RESET	OPTD
OLTS PROTN OPTD	IGEN	RESET	OPTD
67. A-PH START	SPI	START	RESET
67. B-PH START	SPI	START	RESET
67. C-PH START	SPI	START	RESET
67 PROTN OPTD	IGEN	RESET	OPTD
67N PROTN OPTD	IGEN	RESET	OPTD
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
RELAY FAIL (IRF)			
SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
Hardwired Signals-Digital Inputs			
Note : ** Signals duplicated on Soft as well as Hardwired			
LBB OUT SELECTION **	**SPI**	**NORMAL**	**OUT**
67/67N RELAY UNHEALTHY	SPI	HEALTHY	FAIL
3PH GR-A TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
3PH BUSBAR TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
CB TC1 UNHEALTHY	SPI	HEALTHY	FAIL
3PH GR-A TRIP RELAY OPTD	SPI	RESET	OPTD
3PH BUSBAR TRIP RELAY OPTD	SPI	RESET	OPTD
MAIN-1 CARRIER OUT**	SPI	NORMAL	OUT
MAIN-1 87L PROTN OUT**	SPI	NORMAL	OUT
A/R OUT SELECTION**	SPI	NORMAL	OUT
DC-1 FAIL	SPI	HEALTHY	FAIL
PT MCB FAIL	SPI	HEALTHY	FAIL
DIST PROTN Z1 OPTD	SPI	RESET	OPTD
MAIN-1 DT RECEIVE**	SPI	RESET	OPTD
MAIN-1 DT SEND**	SPI	RESET	OPTD
OLTS OUT SELECTION**	SPI	NORMAL	OUT
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-1 AC MCB FAIL	SPI	HEALTHY	FAIL
3PH GR-B TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL

CB TC2 UNHEALTHY	SPI	HEALTHY	FAIL
3PH GR-B TRIP RELAY OPTD	SPI	RESET	OPTD
PTMCB FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL
DIST. PRONT Z1 OPTD	SPI	RESET	OPTD
DC-2 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-2 AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186A RELAY RESET	SCO	NORMAL	RESET
186B RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
LBB IN/OUT SELECTION	DCO	OUT	IN
OLTS IN/OUT SELECTION	DCO	OUT	IN
M1 CARRIER IN/OUT SELECTION	DCO	OUT	IN
M1 87L IN/OUT SELECTION	DCO	OUT	IN
A/R IN/OUT SELECTION	DCO	OUT	IN
Transformer			
Relay-1			
DIGITAL INPUTS (On Soft)			
DIFF. A-PH	SPI	RESET	OPTD
DIFF. B-PH	SPI	RESET	OPTD
DIFF. C-PH	SPI	RESET	OPTD
TRAFO DIFF. 87T PROTN OPTD	SPI	RESET	OPTD
HV O/C. A-PH START	SPI	START	RESET
HV O/C. B-PH START	SPI	START	RESET
HV O/C. C-PH START	SPI	START	RESET
HV O/C DMT PROTN OPTD	SPI	RESET	OPTD
HV O/C IDMT PROTN OPTD	SPI	RESET	OPTD
HV E/F PROTN OPTD	SPI	RESET	OPTD
HV LBB IN SELECTION	SPI	NORMAL	OUT
HV LBB INITIATION	SPI	RESET	OPTD
HV LBB PROTN OPTD.	SPI	RESET	OPTD
HV OVERFLUX PROTN OPTD	SPI	RESET	OPTD
HV OVERLOAD PROTN OPTD	SPI	RESET	OPTD
TRAFO LV STANDBY E/F PROTN OPTD	SPI	RESET	OPTD
MOG (OLTC) ALARM	SPI	RESET	ALARM
MOG (MAIN) ALARM	SPI	RESET	ALARM
BUCH HOLZ ALARM	SPI	RESET	ALARM
PRV-1 (OLTC) TRIP	SPI	RESET	ALARM
PRV-2 (MAIN) TRIP	SPI	RESET	ALARM
BUCH HOLZ TRIP	SPI	RESET	ALARM
OSR TRIP	SPI	RESET	ALARM
RAPID PRESSURE RELAY OPTD	SPI	RESET	ALARM
OTI TRIP	SPI	RESET	ALARM
WTI HV/LV ALARM	SPI	RESET	ALARM
WTI HV/LV TRIP	SPI	RESET	ALARM

OTI ALARM	SPI	RESET	ALARM
A-PH FAULT CURRENT	ANALOG	-	VALUE
B-PH FAULT CURRENT	ANALOG	-	VALUE
C-PH FAULT CURRENT	ANALOG	-	VALUE
87 BLOCK	IGEN	HEALTHY	FAIL
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
MAIN-II RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
M1- SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
M1- SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
LV OLTS OUT SEL.	SPI	NORMAL	OUT
LV OLTS ALARM	IGEN	RESET	OPTD
LV OLTS PROTN OPTD	IGEN	RESET	OPTD
RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
Hardwired Signals-Digital Inputs			
Note : ** Signals duplicated on Soft as well as Hardwired			
HV LBB OUT SELECTION**	SPI	NORMAL	OUT
MAIN-1 RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-A TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
LV-1 3PH TRIP RLAY UNHEALTHY	SPI	HEALTHY	FAIL
LV-2 3PH TRIP RLAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH BUSBAR TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV CB TC1 UNHEALTHY	SPI	HEALTHY	FAIL
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
HV 3PH GR-A TRIP RELAY OPTD	SPI	RESET	OPTD
LV-1 3PH TRIP RELAY OPTD	SPI	RESET	OPTD
LV-2 3PH TRIP RELAY OPTD	SPI	RESET	OPTD
HV 3PH BUSBAR TRIP RELAY OPTD	SPI	RESET	OPTD
MOG(OLTC) ALARM**	SPI	RESET	ALARM
MOG (MAIN) ALARM**	SPI	RESET	ALARM
BUCH HOLZ ALARM**	SPI	RESET	ALARM
PRV-1(OLTC)TRIP**	SPI	RESET	ALARM
RAPID PRESSURE RELAY OPTD**	SPI	RESET	ALARM
OTI TRIP**	SPI	RESET	ALARM
WTI HV/LV ALARM**	SPI	RESET	ALARM
MAIN-1 PT MCB UNHEALTHY	SPI	HEALTHY	FAIL
DC-1 FAIL	SPI	HEALTHY	FAIL

PANEL-1 AC MCB FAIL	SPI	HEALTHY	FAIL
MAIN-2 RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-B TRIP RELAY UNHEALTHY	SPI	HEALTHY	FAIL
HV CB TC2 UNHEALTHY	SPI	HEALTHY	FAIL
HV 3PH GR-B TRIP RELAY OPTD	SPI	RESET	OPTD
PRV-2 (MAIN) TRIP**	SPI	RESET	ALARM
BUCH HOLZ TRIP**	SPI	RESET	ALARM
OSR TRIP**	SPI	RESET	ALARM
WTI LV/HV TRIP**	SPI	RESET	ALARM
OTI ALARM**	SPI	RESET	ALARM
MAIN-2 PT MCB FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL
DC-2 MCB FAIL	SPI	HEALTHY	FAIL
PANEL-2 AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186A RELAY RESET	SCO	NORMAL	RESET
186B RELAY RESET	SCO	NORMAL	RESET
LV1 86 RELAY RESET	SCO	NORMAL	RESET
LV2 86 RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
LBB IN/OUT SELECTION	DCO	OUT	IN
OLTS IN/OUT SELECTION	DCO	OUT	IN
110KV BUSCOUPLER			
DIGITAL INPUTS (On Soft)			
O/C. A-PH START	SPI	START	RESET
O/C. B-PH START	SPI	START	RESET
O/C. C-PH START	SPI	START	RESET
O/C STAGE-1 PROTN OPTD	SPI	RESET	OPTD
O/C STAGE-2 PROTN OPTD	SPI	RESET	OPTD
E/F STAGE-1 PROTN OPTD	SPI	RESET	OPTD
E/F STAGE-2 PROTN OPTD	SPI	RESET	OPTD
LBB PROTN OPTD.	SPI	RESET	OPTD
3PH LBB INITIATION	SPI	RESET	OPTD
LBB IN SEL.	SPI	NORMAL	OUT
SYNCH ON/BYPASS	SPI	NORMAL	IN
TIME SYNCH ERROR	SPI	SYNC	NOT SYNC
LED RESET	SCO	RESET	PERSISTING
RELAY FAIL (IRF)	SPI	HEALTHY	FAIL
M2- SCADA Communication Channel -1	IGEN	HEALTHY	FAIL
M2- SCADA Communication Channel -2	IGEN	HEALTHY	FAIL
SPARE			
SPARE			
SPARE			
SPARE			
Hardwired Signals-Digital Inputs			

Note: ** Signals duplicated on Soft as well as Hardwired			
BUS-1 PT MCB 1 FAIL	SPI	HEALTHY	FAIL
BUS-2 PT MCB 2 FAIL	SPI	HEALTHY	FAIL
NUMERICAL RELAY PT MCB 3 FAIL	SPI	HEALTHY	FAIL
NUMERICAL RELAY SYNCH PT MCB 4 FAIL	SPI	HEALTHY	FAIL
PT-1 SELECTED	SPI	NORMAL	SELECTED
PT-2 SELECTED	SPI	NORMAL	SELECTED
PT INDEPENDENT SELECTED	SPI	NORMAL	SELECTED
DC-1 MCB FAIL	SPI	HEALTHY	FAIL
DC-1 FAIL	SPI	HEALTHY	FAIL
DC-2 FAIL	SPI	HEALTHY	FAIL
DC-2 MCB FAIL	SPI	HEALTHY	FAIL
3PH 86 TRIP RELAY FAIL	SPI	HEALTHY	FAIL
3PH BB TRIP RELAY FAIL	SPI	HEALTHY	FAIL
3PH 86 TRIP RELAY OPTD	SPI	RESET	OPTD
3PH BB TRIP RELAY OPTD	SPI	RESET	OPTD
TC-1 UNHEALTHY	SPI	HEALTHY	FAIL
TC-2 UNHEALTHY	SPI	HEALTHY	FAIL
50/51 RELAY FAIL	SPI	HEALTHY	FAIL
LBB IN SELECTION**	SPI	NORMAL	IN
SYNCH IN SELECTION**	SPI	NORMAL	SELECTED
AC MCB FAIL	SPI	HEALTHY	FAIL
Hardwired Signals-Digital Outputs			
186 RELAY RESET	SCO	NORMAL	RESET
196 RELAY RESET	SCO	NORMAL	RESET
BUS1 PT SELECTION	SCO	NORMAL	SELECTED
BUS2 PT SELECTION	SCO	NORMAL	SELECTED
IND. PT SELECTION	SCO	NORMAL	SELECTED
SYNCH IN/OUT SELECTION	DCO	IN	OUT
LBB IN/OUT SELECTION	DCO	IN	OUT

Note: The above IO list is indicative. However, the final IO list will be reviewed and finalized during detailed engineering, as per the design requirement (Conventional & Process bus based digital Substation Bays)

All Lockout relay reset ,IN/OUT commands from SCADA will be on soft through IEC61850 as per specification.

Annexure – IV (Separately Attached)

a) Standard Quality Plan for (Conventional Substation Automation System)

END

Switchgear Control Unit (SCU)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Switchgear Control Unit (SCU)	Modular, It shall part of a larger Protection & Merging Unit (MU) family	
2	Make		
3	Model		
4	Digital Input Points (Physical)	64	
5	Digital Output Points (Physical)	20 (The DO should able to carriedout Operations of high rated the equipment viz. Breaker, Isolator, Earthswitch, TAP Raise/low etc.)	
	Close / Open	Required	
	Raise / Lower	Required	
6	Analog Inputs (Physical)	0	
7	Multifunction Meters / Numerical Relays Integration	Facility to interface Multifunction Meters and Numerical Relays	
7.1	Accumulator Data from Multi-Function Meter	Capable of Acquiring 32 bit Analog and Accumulator Data from Multifuntion Meters	
8	Distributed I/O modules	Required	
9	Ports Requirement and type	All ports shall be galvanically isolated	
		a) 2 nos. Fibre Optic port or Redundant Ethernet port 100/1000 MBPS for Process Bus	
		The SCU shall be connected on Fibre Optic / Ethernet, redundant communication with Station Bus	
	For structuring (Configuration) system (separate port)	A galvanically isolated USB port for local engineering through laptop	
10	Pseudo Points (Digital, Analog)	Required	
11	Calculated Points (Digital, Analog)	Required	
12	Calculated Digital Points	Unlimited	
13	SOE List storage	Min 1000 (shall be user configurable)	
13.1	SOE list Retention Period	1 Month	
14	Fault Disturbance Record	Min 5 of 3 min duration	
14.1	FDR List Retention Period	1 Month	
15	Time Synchronization	Required on IEEE1588, SNTP and acceptance of direct pulse (1 PPS, 1 PPM). SCU shall have capability for Time Synchronization from Minimum 2 Server with priority selection	
16	Development of Interlock logic	Required, Mandatory	
17	Protocol & Standard Support	IEC 61850-9-2LE, IEC61850 Ed1 & 2,IEEE1588 V2 (PTP),IEC 62439-3 (PRP & HSR), IEC 61784, SNMP v1,v2,v3	
17.1	Vendor shall specify all other protocol supported by SCU along with BID	Bidder to furnish data	
18	I/O handling capacity	Min 750 physical tags / SCU	
19	Support of mathematical function - Arithmetic, Logical, Trigonometric functions, differential and integration functions, filpflops,timer, counter etc.	Required, Mandatory	
20	Logic and calculation functionality	Required, Mandatory	

Switchgear Control Unit (SCU)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
21	**Response Time**		
	Digital Input	As per Sampling rate defined in the specification	
	Analog		
	Digital Output		
22	Real time stamping at SCU level, I/O level	Required, Mandatory	
23	Check-Before-Execute Scheme for control	Required (Bidder shall submit their Check-before-Execute scheme)	
24	Communciation Network response	Bumpless/Seemless/Zero recovery time	
25	Status LEDs on all module – for fault indication and each Inputs / Outputs	Mandatory	
26	Module replacement in SCU	Hot-Swappable module	
27	Software – All diagnostic tools, simulator tool, maintenance tools, configuration application for database and process control program development, documentation and maintenance	Required	
28	Engineering Functions & Cybersecuirty Features	a) Configuration shall be possible both locally and remotely	
		b) SCU shall have multilevel passwords	
		c) On-line monitoring facility of real time data for monitoring/analyzing the real time status of the process, program logic from the engineering station	
		d) Allow configuration of the SCU with different versions of the Configuration Tool	
		e) ICD file generation shall be possible from the proposed Configuration Tool	
		f) SCU must have the provision to configure the IP of the redundant Gateway (Socket IP)	
		g) Comply to NERC CIP/IEC62443 standard	
		h) Secure Access & User credentials - Refer Specifications	
		i) KEMA Certified - Mandatory	
		j) Web browser support - Yes , required	
29	Conformal Coating	Yes, Mandatory	
29.1	IP class	IP64	
30	Battery Backup / Flash-PROM backup	Required	

Remote Terminal Unit (RTU)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Remote Terminal Units (RTU)	19" Modular, It shall have capability to be part of a larger RTU family	
2	Make		
3	Model		
4	Digital Inputs (Physical)	As specified in the I/O Requirement	
5	Digital Outputs (Physical)	As specified in the I/O Requirement	
	Close / Open	Required	
	Raise / Lower	Required	
6	Analog Inputs (Physical)	As specified in the I/O Requirement	
7	Energy Meters / Numerical Relays Integration	Facility to interface Multifunction Meters and Numerical Relays	
7.1	Accumulator Data from Multi-Function Meter	Capable of Acquiring 32 bit Analog and Accumulator Data from Multifuntion Meters	
8	Distributed I/O modules	Required	
9	Ports Requirement and Type	All ports shall be galvanically isolated	
		a) 8 nos. RS 485 Port, 2 nos. RS 232 Port	
		b) 2 Nos. Fibre optic port or Redundant Ethernet port 100/1000 MBPS, depending on the configuration proposed by the Bidder	
		The RTU shall be connected on Fibre Optic/Ethernet, 100/1000 Mbps & communicate with the Gateway using lEC61850.	
	For Structuring (Configuration) System (Separate Port)	A galvanically isolated USB port for local engineering through laptop	
10	Protocol Support	IEC 61850, IEC 60870-5-103, IEC60870-5-104 (Master & Slave), MODBUS (Serial & RTU), SNTP & IEEE1588 V2 with Server and Client licenses	
	Vendor shall specify all other Protocol supported by RTU along with BID.	Bidder to furnish data	
11	Time synchronization between RTU, I/O modules, IEDs and Gateway	Required on IEEE1588, SNTP and direct pulse (1 PPS, 1 PPM). RTU shall have capability for Time Synchronization from Minimum 2 Server with priority selection	
	Real time stamping at RTU level, I/O level	Required, Mandatory	
12	**Response Time**		
	Digital Input	1 msec or better	
	Analog	1 sec or better	
	Digital Output	<1 sec or better	
13	I/O handling Capacity	Min 5000 Physical Tags / RTU	
14	Pseudo Points (Digital, Analog)	Required	
15	Calculated Points (Digital, Analog)	Required	
16	SOE List storage	Min 1000 (shall be user configurable)	
	SOE list Retention Period	1 Month	
17	Fault Disturbance Recorder	2000 events	
	FDR Retention Period	1 Month	

Remote Terminal Unit (RTU)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
18	Development of Interlock logic	Required, Mandatory	
19	Support of mathematical function - Arithmetic, Logical, Trigonometric functions, Differential and Integration functions, Timer, Counter etc.	Required, Mandatory	
20	Logic and Calculation functionality	Required, Mandatory	
21	Check-Before-Execute Scheme for Control	Required (Bidder shall submit their Check-before-Execute scheme)	
22	Auxiliary Relays for Digital Outputs	Required, Auxiliary relays with Min 10 Ampere rating with 2 NO contacts (to be wired in Series) for each digital outputs	
23	Status LEDs on all module – for fault indication and Inputs / Outputs	Required	
24	Module replacement in RTU	Hot-Swappable module	
25	Software – All diagnostic tools, simulator tool, maintenance tools, configuration application for database and process control program development, documentation and maintenance	Required	
26	Engineering Functions	a) Configuration shall be possible both locally and remotely	
		b) RTU shall have multilevel passwords	
		c) On-line monitoring facility of real time data for monitoring/analyzing the real time status of the process, program logic from the engineering station	
		d) Allow configuration of the RTU with different versions of the Configuration Tool	
		e) ICD file generation shall be possible from the proposed Configuration Tool	
		f) RTU must have the provision to configure the IP of the redundant Gateway (Socket IP)	
27	Cyber Security	Bidder to confirm Cyber security measures as indicated in the Specification	
28	Battery Backup / Flash-PROM backup	Required	

GPS Receiver with Frequency, Time & Date Display			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	Network support	Multiple LAN network topology Multiple IEEE1588 V2 /PTP & SNTP ports supporting different IP networks (as per the specification)	
4	Tracking	GPS-L1, C/A code (1575.42 MHz), Minimum 12 channel (tracks up to 12 satellites) or more Minimum Accuracy 1 microsecond or better Code/Carrier tracking	
5	Front Keypad	For Configuration of Local time offset, Output code select, Backlight control, Out-of-lock time, Auto-Survey, Position, Event input, Antenna delay, Programmable Pulse setup, Off or Zero delay, Serial and IP port configuration.	
6	Redundant High Interference GPS Antenna and mounting adapter kit	Required, Mandatory	
7	IEEE1588 V2,NTP,SNTP Server	Mandatory	
8	Mounting Type	19" Rack Mountable, Size : 2 U, Chassis: Rack Chassis w/sliding Rapid/Versa Rails and Cable management Arm, with all other mounting accessories	
9	LED Indicators and LCD Display	**LED Indicators :** Power, Watchdog, GPS Locked, Event, GPS Sata	
		LCD display for: 4-rows x 40-character backlit LCD, Functions- showing local date and time, Position: latitude, longitude, altitude, Receiver and clock status, Deviation, Event time.	
10	Outputs	**TCP/IP**	
		Min 4 Nos. independent SNTP Ports for Station Bus & Minimum 4 Ports for Process Bus on IEEE1588 V2	
		GPS Clock shall have suitable format / software for IEEE1588 / NTP / SNTP to broadcast the time on TCP/IP network to all devices	
		IP address of the GPS shall be user configurable	
		Pulse	
		4 Nos. Potential free contact (minimum pulse duration 50 msec). The pulse output shall be user configurable to provide pulse rates of 1 PPS, 1 PPM, 1 PPH, accuracy < 1 micro-second with GPS locked contacts suitable for 220 V DC, 100 mA	
		Serial	
		2 Nos. RS 232C serial port for configuration and synchronous time string broadcast, capable of giving time in format to suit various applications such as UNIX / LINUX / Windows server, simultaneously. 1200 – 19200 baud, 7 or 8 data bits, 1 or 2 stop bits; Even / Odd / No Parity	
		Potential Free Contacts for Alarms	
		Dry and isolated alarm contacts for GPS Sync Lost, Power Failure, Watchdog and 1 spare (Configurable)	
		IRIG-B	

GPS Receiver with Frequency, Time & Date Display			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
		IRIG-B amplitude modulated time code signal	
		IRIGB – 1 kHz, TTL pulse, positive edge on time	
		RS232/RS485 Port	
		2 Nos. RS485 / RS232 port with driver	
11	Antenna	Type – Helical	
		Axial Ratio – 5dts – 5db	
		Noise < 1 db	
		Operating Temperature - 30°C to +80°C	
		Connector – N or BNC-J	
		Output Data - NEMA 0183 format	
		Coaxial Cable – Low loss cable, Minimum 50 m length cable for connecting to antenna and an option to extend the cable length (Actual length shall be decided at the time of detailed engineering).	
		Mounting – Fixed (sky view) outdoor	
		Weather Condition – All seasons	
		Weight of the Antenna – less than 0.5 kg	
		Lighting Arrester – Mandatory	
		Redundant Antenna for each GPS receiver - Required with all necessary mounting accessories	
12	Remote Time & Frequency Display	Display : Time: HH:MM:SS:SSS in 24 hrs format, Frequency – XX.XXX Hz	
		Display size: 100 mm 7 Segment RED LED	
		Input : From GPS receiver	
		Connection: from GPS Receiver Serial Communication / Wireless Remote Display	
		Signal Updation: Continuous, Every Second	
		Each digit on the time, day and frequency indicators shall be at least 7.5 cm in height and shall be bright enough for adequate visibility in the control room from a distance of 15 meters	
		Redundant Power Supply 110V DC/220VDC or 230 V AC with battery backup (bidder to provide details for offered battery back-up) The GPS Receiver shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
		Environment: Display Units with accessories will be installed in the Relay/Control room with no temperature or humidity control. The Display Units shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
		Mounting: Wall mounting with all necessary mounting accessories & kit.	
		GPS / IRIG-B < 1 Microsecond	
		IEC61850-9-2 LE, IEC 62439-3 (PRP & HSR), IEC61850 Ed1&Ed2, IEC104, Modbus RTU	

GPS Receiver with Frequency, Time & Date Display			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
13	Expected Accuracy	NTP, SNTP: WAN < 10 msec LAN < 1 msec	
		IEEE 1588 : < 10 microseconds or better	
14	Remote Monitoring	SNMP v1,v2,v3 for Monitoring from Remote	
15	Cybersecurity	NERC CIP, IEC62443 standard	
15.1	Syslog reporting	Yes,Mandatory	
15.2	Management	Shall be Managed from Remote throgun secured Access	
16	Conformal Coated	Yes,Mandatory	
17	IP class	IP64	
18	Power Supply	Redundant Power supply module of 48V DC. The Equipment shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
19	Electronic Earthing	Provision of electronic earthing to the nearest grounding box/earth pit	
20	Environment	GPS Receiver with accessories will be installed in the Gateway Panel with no temperature or humidity control. The GPS Receiver shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
21	Other Required Features	Offset Adjustment	
		Propogation Delay Compensation to achieve overall accuracy of < +/- 1.5 microseconds	
		Internal time base stability < 1 PPM or better	
		Web-Interface for Configuration	
		Amplifier to be included if required	

Managed Layer - 2 Switch			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	Type of Switch	Industrial Grade, 19" Rackmountable	
4	No. of Ports per switch	Minimum 24	
4.1	No. of Copper ports (10/100 mbps)	As per Bidder's Proposed Architecture	
4.2	No. of Fiber Ports (100/1000 mbps)	As per Bidder's Proposed Architecture	
4.3	SFPs to be considered for fiber ports	Required, Mandatory	
4.4	Copper Ports	2nos Minimum & Mandatory	
5	**Compliance**		
5.1	Shall support 802.1Q VLAN, 801.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol and also suitable for Ring Configuration	Required	
5.2	IEEE 1613 compliance	Mandatory	
5.3	IEC 61850 Compliance	Mandatory	
5.4	IEC 62439-3	Mandatory	
5.5	QAS (802.1p)	Mandatory	
6	Time Synchronization	SNTP, IEEE1588 V2	
7	Suitable for PRP/HSR architecture	Mandatory, As per proposed Architecture	
8	Other Required Features	Automatic Learning, Ngotiation, and Crossover Detection	
		Support Industrial Automation Protocols i.e. IEC61850, MODBUS, Ethernet/IP etc.	
		Shall support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden for VLANs Configuration	
		Shall support both Rapid Spanning Tree Protocol (RSTP) & Multiple Spanning Tree Protocol (MSTP)	
		Port Mirroring	
		Discover the neighboring device, giving the details about the platform, IP Address, Link connected through etc.	
		Shall support to prevent edge devices not in the network administrator's control from becoming STP root nodes	
		Shall support configuratble SNMP traps	
		Syslog Reporting, Mandatory	
9	Management Tools support	Web-based, Telnet & Command Line Interface (CLI) for quickly configuring major managed functions	
		SNMPv1/v2c/v3 for different levels of network management	
		Remote Monitoring (RMON)	
		Rich set of diagnostics with logging and alarms	
10	Auxiliary Power Supply	Redundant Power supply module of 48V DC or 110 / 220 V DC +/- 20 % shall be available (Based on the Architecture proposal). The Switch shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
11	Health Monitoring of Hardware such as Ethernet ports, Power supply cards & Communication links and internal voltages through SNMP to Gateway	Mandatory	

Managed Layer - 3 Switch (SAS)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	No. of Ports	24	
3.1	No. of copper Ports (10/1000 mbps)	16 Minimum	
3.2	No. of Fiber Ports (100/1000 mbps)	8 Minimum	
3.3	PRP & HSR Support	Mandotary	
4	Layer 3 features	Non-Blocking L3 switching	
		Static IP routing	
		Dynamic Routing Protocols – RIP, RIP v1/v2, RIPng OSPF (Day 1) and BGP (scalable)	
		VRRP	
		LACP	
		Shall support IP v6 in hardware without any additional module	
		IGMP, multicast routing (scalable)	
		Policy based routing	
		LACP	
		OSPF routes – min 500 table entries	
5	Layer 2 features	MAC address table size min 4K	
		Shall support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden for VLANs Configuration	
		Port aggregation using IEE 802.3	
		Shall support 802.1Q VLAN, 801.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol and also suitable for Ring Configuration	
		Port Mirroring	
		Discover the neighboring device, giving the details about the platform, IP Address, Link connected through etc.	
		Shall support to prevent edge devices not in the network administrator's control from becoming STP root nodes	
		Automatic Learning, Ngotiation, and Crossover Detection	
6	Virtual Switching Features	Common Virtual Switch control plane for both switches	
		Common Virtual Switch Active Data plane for both switches	
		VRRP, VSS, Stacking or equivalent HA solution	
		Min 20 Gbps bandwidth on the high availability link between switches	
		Switches shall support Ring resiliency protocols (RPR / EPSR) to ensure sub 50 ms convergence	
7	QOS Features	Per port egress queues	
		Priority queuing	
		Custom queuing	
		Traffic policing	

7	QOS Features	Traffic shaping	
		Traffic marking and classification	
		Congestion avoidance using WTD or WRED	
		Cross stack QOS	
8	Security features	Port level access list	
		Dynamic ARP inspection	
		IP score guard	
		MAC binding	
		Per port storm control	
		Secure admin access over SSH	
		Admin access restrictions	
		IEEE 802.1x	
		AAA using RADIUS / TRACS+	
		Security encryptions	
		Private VLANs	
9	Management features	SNMP v2c, V3	
		Configurable SNMP traps	
		Logging to Syslog with time stamp	
		NTP support	
10	Power Supply	Redundant Power supply module of 48V DC. The Equipment shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
11	Environment	Switch with accessories will be installed in the Gateway with no temperature or humidity control. The equipment shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
12	Health Monitoring of Hardware such as Ethernet ports, Power supply cards & Communication links through SNMP	Protocol shall be SNMP	

Multi- Function Meter (MFM)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	Accuracy Class	Class 0.2S / 0.5S (IEC62053-11 and IEC62053-22)	
4	Sampling rate	128 Samples/Cycle for true RMS measurement	
5	Voltage Input	0 to 690 V L-L, 400 V L-N	
	Voltage Burden	< 0.15 VA	
	PT Ratio	1.0 - 6500	
	Primary Value of PT	Shall be programmable	
	Range of Reading	1 - 999000 V	
6	Current Input	1 A / 5A selectable from the front display	
	CT Burden	< 0.1 VA per phase	
	CT range	0.1% to 200%	
	Current over range	5A CT = 15A RMS continuous, 250A for 1 Sec 1A CT = 3A RMS continuous, 50A for 1 Sec	
	Range of Reading	0-60000 Amp	
	Primary Value of CT	Shall be programmable	
7	Power Factor	0.5 (lag) to 1.0 (unity) and 1.0 (unity) to 0.5 (lead)	
8	Accuracy kW / kWH	0.5 S as per IEC62053:22	
9	Real time & Average parameters	Required	
10	Four Quadrant measurement	Required	
11	LED Load Bar Indication	Optional	
12	Self-Diagnostic LED	Required	
13	Real time clock	Required	
14	Min./Max of parameters	Required	
15	THD	Required	
16	Individual Harmonics upto 39th	Required	
17	Real time waveform monitoring	Standard software to monitor real-time waveform	
18	Communication Port	Min 1 no. RS 485 port	
19	Isolation	Galvanic	
20	Communication protocols	MODBUS RTU, ASCII, selectable at site	
21	User defined registers	Preferred	
22	Energy pulse LED for calibration test	Required	
23	Relay output	Optional	
24	Auxiliary Power Supply	Universal Power Supply with 85V to 265 V AC and 88 -290 V DC The MFM shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	

25	Environment	MFM will be installed on the LCP Panel / Relay / Control room with no temperature or humidity control. The MFM shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
26	Mounting Panel cutout	92 mm x 92 mm, flush mounting	
27	Programming features	The meter should allow the user to configure the registers for the electrical parameters.	
		Unit should be fully programmable in the field and also remote configuration including PT/CT ratios and should have adequate protection for authorization for changes.	
28	Parameters to be monitored and reported:	Volt, Amp, Cos (Phi), kWatt, kvar, kVA, HZ, MWH Import & Export, MVARH Import & Export.	

Engineering Station (Laptop)			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	Hardware	Laptop with latest processor, 64 bit, 500 GB HDD, 8 GB RAM, DVD RW, 4 USB Ports, 15" Display with 1 no. serial to USB converter	
4	Software	Microsoft Windows & Office License	
		Antivirus software	
		BCU, Gateway Configuration Software	
		IEC61850 Configuration Tool	
		RTU/BCU/GW, Master Simulation & Protocol Analyzer Software	
5	Accessories	Wireless Mouse & Laptop Bag	
6	Auxiliary Power Supply	230V AC	

Temperature & Humidity Sensor			
SL. NO.	**TECHNICAL PARTICULARS**	**TATA POWER REQUIREMENT**	**BIDDER RESPONSE**
1	Make		
2	Model		
3	Operating Range	-40.0 to + 85 °C (Temperature)	
		0.0 to 100.0% RH (RH)	
4	Measuring Range	-40.0 to + 65 °C (Temperature)	
		0.0 to 100.0% RH (RH)	
5	Temperature Accuracy	+/- 0.1 °C	
6	RH Accuracy	+/- 0.1 % RH @ 24 °C	
7	Long term stability for humidity sensor	< 1% RH / Year	
8	Local Display	4 Digit (min), red, Seven Segment Display, Independent displays for T & % RH, Visible at least from 15 mtrs.	
9	Output for Temperature & % RH	Isolated 4 wire / 3 wire RS 485 electrical port with MODBUS RTU protocol	
10	Min / Max Load	V-signal ≥ 1Kohms/V, mA-signal ≤ 500 ohms	
11	Front Keyboard	Required for programming and calibration (if applicable)	
12	Enclosure (Size)	Robust Industrial Housing, Suitable for Internal and External use	
	Additional Enclosure for Outdoor Application	Transmitter shall be mounted in the industrial grade weather proof Box	
13	Mounting Arrangement	Wall mounted, with necessary mounting arrangement for internal and external use	
14	Protection	Necessary protection shall be provided for the sensors	
15	Protection Rating	IP 65	
16	Data Logging	Optional	
17	Self-Diagnostic LED	Required	
18	Power Supply	Universal Power Supply with 85V to 265 V AC or 88 -290 V DC +/- 10% The Sensor shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
19	Environment	Sensor will be installed in the Switchyard/GIS, Switchgear rooms,Battery Room, Control & Relay room etc. where no temperature or humidity control is available.	

Indicative BOM for Automation System at Kolshet Rss for 110kV Bays				
Option-1 (Conventional Automation for Transformer-3, Transformer-4 and Transfer Breaker Bays)				
Sl. No.	**Item**		**Item Description**	**Qty**
Supply				
1	**Ethernet Switches, and Networking Accessories**	**1.1**	**Managed L2 Ethernet Switches for Numerical Relay, Misc RTU Communication & for Gateway Integration** **Mounting Arrangement:** To be mounted in Relay panels / Separate Network Panel **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on Relay quantity & Relay port with 20% spare FO and CU ports on each switch. However, **minimum qty shall be 2 nos.**	1 Set
		1.2	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) unarmoured multistrand pair and overall shielded for serial communication	500 mtrs
		1.3	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) armoured multistrand pair and overall shielded for serial communication	500 mtrs
		1.4	Armoured CAT6 UTP Cable	1000 mtrs
		1.5	Un-Armoured CAT6 UTP Cable	305 mtrs
		1.6	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	1000 mtrs
		1.7	Networking accessories like LIU, patch panel (for each Ethernet switch), patch chords (Fibre optic, UTP) of suitable length, Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc.	1 LOT
2	**Miscellaneous RTU Panel**	**2.1**	**Pre-wired Miscellaneous RTU Panel with all accessories** **I/O Requirement:** with 128 DI, 64 DO, 16 AI with Auxiliary Relays for each Digital Output **Mounting:** To be supplied with prewired panel (Rittal or equivalent, size : 2300 mm x 800 mm x 800 mm, both side opening)	2 Sets
3	**MFM**	**3.1**	Multi-Function Meter (SATEC 130EH+)	4 nos
4	**Spares**	**4.1**	**Mandatory Spares (Refer specification)**	1 Set
Services				
I1	**Installation, Integration and Commissioning of SAS System**	**I1.1**	**Installation, Integration and Commissioning of SAS System** a) Engineering b) Installation and commissioning of all supplied items c) Cable termination, continuity check of all communication cables d) All Protection Relay,BCU, RTU, MFM looping and Integration with existing Gateway e) Preparation of ICS and Signal List f) Configuration and Testing of IED's, RTUs, Gateway etc. g) Time Synchronization of Gateway, DRCA, IEDs with GPS Receiver h) Integrated testing with purchasers existing Unified SCADA System i) I/O testing, Pre- SAT testing of Hardware and Software functionality j) Integrated FAT & SAT for Hardware and Software k) Submission of as-built drawing in AutoCAD and PDF Format	Lumpsum
		I1.2	Warranty for Supplied Hardware & Software inclusive of patch management and software upgradation for the period of 5 Years	
	Gateway Services	**I1.3**	Services from APPSIL (ABB) for the Gateway Configuration, Testing and Integration of supplied items/systems at 110kV Kolshet RSS	Lumpsum
	DRCA Services	**I1.4**	Services of M/s Kalkitech for Configuration, integration with both local DRCA System of the respective station & Centralised DRCA system at 110kV Kolshet RSS	Lumpsum

Indicative BOM for Automation System at Kolshet Rss for 110kV Bays				
Sl. No.	**Item**		**Item Description**	**Qty**
Option-2 (Process Bus Based Digital Substation for 110kV Tfr-3,Tfr4 & Transfer Breaker Bays)				
O1	Process Bus Panel for Transfer Breaker	O1.1	**Redundant MUs with BI/BOs along with accessories per Bay for Transfer Breaker** **IO Requirement & Quantity :** Refer Protection Specification **Communication Port :** Redudant Fiber Optic Ports on PRP **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Mounting:** To be installed in the Process Bus Panel	1 Set
		O1.2	**Non -redundant SCUs with accessories per Bay for BCU for Transfer Breaker** **I/O Requirement :** with 64 DI, 20 DO **Communication Port :** Redudant Fiber Optic Ports **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Quantity** - 1no **Mounting:** To be installed in the Process Bus Panel along with MUs	1 Set
O2	Process Bus Panel for Tranformer	O2.1	**Redundant MUs with BI/BOs along with accessories per Bay for Tranformer** **IO Requirement & Quantity :** Refer Protection Specification **Communication Port :** Redudant Fiber Optic Ports on PRP **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Mounting:** To be installed in the Process Bus Panel	2 Sets
		O2.2	**Non -redundant SCUs with accessories per Bay for BCU** **I/O Requirement :** with 64 DI, 20 DO **Communication Port :** Redudant Fiber Optic Ports **Power Supply:** Redundant 220 V /110 V DC **Conformal Coating :** Yes Quantity - 1no **Mounting:** To be installed in the Process Bus Panel along with MUs	2 Sets
O3	GPS Receiver	O3.1	**Redudant GPS Receiver ,Clock with Time, Date and Frequency Display Unit with antenna, Surge protector and cables for Process Bus & Station Bus** **Mounting Arrangement :** GPS Receiver to be mounted in Gateway Panel **Ports :** 4nos of IEEE1588 (PTP) FO/Ethernet Ports for Process Bus & 4nos SNTP Ports for Station Bus Communication **Power Supply**: Redundant 220 V /110 V DC Mounting : Shall be mounted in Gateway panel. **Remote display Mounting :** Time, Date and Frequency Display Unit on a wall in C/R or R/R	1 Set
O4	Process Bus Communication Switches, Networking Accessories forSAS	O4.1	**Pre-wired Network Panel (Near Process Bus Panel) with Managed L3/L2 Ethernet Switches for Process Bus equipment integration with Station Bus** **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on IED quantity & ports with 20% spare FO and CU ports on each switch. **Communication Network :** PRP **Power Supply:** Redundant 220 V /110 V DC **Mounting Arrangement:** To be mounted in a Separate Network Panel.	1 Set
		O4.2	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	2000
		O4.3	Armoured CAT6 UTP Cable	500
		O4.4	Networking accessories like Redundant LIU, Redudant patch panel (for each Ethernet switch), Pre-fabricated Patch cords (Fibre optic, UTP) of suitable length, Unarmoured UTP Cables,HDPE Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc. (Refer the specifications more details)	1Lot
O5	Station Bus - Bay Control Unit (BCU)	O5.1	**Non-Redundant BCU for Transfer Breaker & Transfromer** **Power Supply :** Redundant 220 V /110 V DC **Conformal Coating :** Yes **Communication port :** Independent Redundant FO Port for Process Bus and Station Bus **Mounting:** To be installed in the Protection relay Panel along with the protection relays	3 Sets
O6	Pre-wired RTU Panel	O6.1	**Pre-wired RTU Panel with all accessories** **I/O Requirement:** with 128 DI, 64 DO, 16 AI with Auxiliary Relays (Omron Relay)for each Digital Output **Mounting:** To be supplied with prewired panel (Rittal make ; size : 2300 mm x 800 mm x 800 mm, both side opening)	1 Set

O7	Communication Switches, Networking and other Accessories	O7.1	**Managed L2 Ethernet Switches for Numerical Relay, Misc RTU Communication & for Gateway Integration** **Mounting Arrangement:** To be mounted in Relay panels / Separate Network Panel **Qty:** Nos. of Switches, Nos. of FO & Copper ports in each switch will be based on Relay quantity & Relay port with 20% spare FO and CU ports on each switch. However, **minimum qty shall be 2 nos.**	1 Set
		O7.2	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) unarmoured multistrand pair and overall shielded for serial communication	500 mtrs
		O7.3	**Communication Cable:** 4P X 0.36 Sq.mm (Reputed Make) armoured multistrand pair and overall shielded for serial communication	500 mtrs
		O7.4	Armoured CAT6 UTP Cable	1000 mtrs
		O7.5	Un-Armoured CAT6 UTP Cable	305 mtrs
		O7.6	Armoured Fibre Optic Cable for SCADA 8 core, MM/SM	1000 mtrs
		O7.7	**Configuration Laptop** **Hardware:** Laptop with latest processor, 500 GB HDD, 8 GB RAM, DVD RW, 4 USB Ports, 15" Display with 1 no. serial to USB converter **Power Supply:** 230 V DC Microsoft Windows compatible with latest version of configuration software, latest Microsoft Office License pack, Antivirus Quick heal Total Security with three-year subscription, Configuration & maintenance software tools, Diagnostic tools. Logic building Application of SCU,BCU,RTU and Process Bus related Configurations	1 Set
		O7.8	Networking accessories like LIU, patch panel (for each Ethernet switch), patch chords (Fibre optic, UTP) of suitable length, Conduits for all non-armoured cables, I/O boxes with Quad face plate, RJ45 connectors etc.	1 Lot
O8	MFM	O8.1	Multi-Function Meter (SATEC 130EH+)	4 nos
O9	Spares	O9.1	Mandatory Spares (Refer specification)	1 Set
I1	Installation, Integration and Commissioning of SAS System	I1.1	**Installation, Integration and Commissioning of SAS System** a) Engineering b) Installation and commissioning of all supplied items c) Cable termination, continuity check of all communication cables d) All Protection Relay,BCU, RTU, MFM looping and Integration with existing Gateway e) Preparation of ICS and Signal List f) Configuration and Testing of IED's, RTUs, Gateway etc. g) Time Synchronization of Gateway, DRCA, IEDs with GPS Receiver h) Integrated testing with purchasers existing Unified SCADA System i) I/O testing, Pre- SAT testing of Hardware and Software functionality j) Integrated FAT & SAT for Hardware and Software k) Submission of as-built drawing in AutoCAD and PDF Format	Lumpsum
		I1.2	Process bus Based Digital Substation - Warranty for Supplied Hardware & Software inclusive of patch management and software upgradation for the period of 10 Years	
	Gateway Services	I1.3	Services from APPSIL (ABB) for the Gateway Configuration, Testing and Integration of supplied items/systems at 110kV Kolshet RSS	Lumpsum
	DRCA Services	I1.4	Services of M/s Kalkitech for Configuration, integration with both local DRCA System of the respective station & Centralised DRCA system at 110kV Kolshet RSS	Lumpsum

Services for OSI SCADA

TATA POWER	The Tata Power Company Limited Corporate Engineering-Quality Assurance & Inspection	TATA
TPQA&I-QAXX-00-EX-SQP-371 REV.0	STANDARD QUALITY PLAN FOR SCADA SYSTEM.	Date of Issue: 15-10-2018

Sr. No	COMPONENT / OPERATION	CHARACTERISTICS TO BE CHECKED	TYPE / METHOD OF CHECK	REMARKS
1	2	3	4	5
1.0	**MATERIAL: (As per technical specification/ drawings/ approved data sheet).**			
1.1	Sheet Steel, CRCA	Thickness, dimensional, surface finish, bend test/ mechanical tests & Chemical Analysis.	MTC & Report verification as per approved datasheet/ specification & inward material inspection by system supplier.	Correlated manufacturer TC & Inspection report verification by Tata Power.
1.2	Server, Ethernet switch, HMI, Workstation, Terminal Server, RTU, BCU, Gateway, Interposing Relays Firewall, Multi-Function Meters, Media Converters & Power supply.	1. BOM verification, 2. Configuration checks, 3. Warrenty clauses. 4. Cyber security checks (wherever applicable).		
1.3	Control Cables & its accessories.	Type & rating of cable, Color check, No. of Strands , Conductor resistance, shielding, dimensional checks, HV test, Insulation resistance; FRLS tests.		
1.4	Fibre Optic Cable, Patch Cords, Fibre Optic Termination equipment and Fibre Management Panel.	Wavelength, Type (SM/MM), Length, Interface Ports.		
1.5	Fibre Multiplexer, Protection Coupler, PLCC, WAN Network Switch.	BOM verification, Configuration and Functional checks		
1.6	GPS system (As applicable)	Type & Make.		
		Range & Functional checks.		
2.0	**INPROCESS INSPECTION: (Generally in line with manufacturer standard).**			
2.1	Cabinet Assembly of system.	Visual & Dimensional checks.	Testing & Measurement to be carried out by manufacturer.	Verification of Records by Tata Power.
		Check for Mounting of components, labelling, dressing, ferruling & wiring continuity, gland plate installation and earthing.		
		Check compatibility of interface modules & SCADA system.		
		HV test on internal wiring at 2kV & IR test.		
3.0	**FINAL TEST & INSPECTION: (As per approved drawings/ data sheet, technical specification and relevant standards) - Customer Hold Point (CHP)**			
3.1	Acceptance Test	BOM, Visual & Dimensional checks.	Testing & measurement as per approved GA drawing, specification/ datasheet/ FAT procedure.	CHP
		Check for panel thickness, paint shade & thickness, ferruling, continuity, color coding of panel wires & Terminal Blocks.		
		Check for isolation between electronic component grounding & panel grounding.		
		Check for power up sequence test.		
		Check behaviour of modules during U/V or O/V.		
		System architecture & configuration check for server, its license, Hardware components, DR (Disturbance Recorder) collector & DR analysis system, firewall, power supply and other interface modules.		
		Functional & Integration tests for hardware & software operations.		
		Check for integrated testing of IEDs (Intelligent Electronic devices) with Gateway.		

	Acceptance Test	Verification of database as per I/O list, interlock logics, etc.	Testing & measurement as per approved GA drawing, specification/ datasheet/ FAT procedure.	CHP
		Check Time synchronization of SCADA system (including HMI & ethernet switches), IEDs & Gateway with GPS system.		
		Check time stamping of alarms & events.		
		Check for Mimics & Displays, Reports & Trends.		
		Check for redundancy of SCADA & communication system.		
		Check for IED parameterization (i.e. communication & configuration of IEDs through softwares).		
		Simulation for verification of specified automatic download of DR to DR collector.		
3.2	Type tests	1. IP class for the enclosure, 2. Burn-in test / System to run for 48hrs. 3. Compatibility test of H/W & S/W for Gateway, SCADA, Communication system & IEDs. 3. Protocol (PICS, MICS (Protocol & Model Implementation Conformance Statement) documents for IEC 61850/MODBUS/IEC103/IEC104 compliance) compatibility test for Gateway & IEDs.	Verification of TC/ as indicated in specifications.	Valid type test certificates not older than 5yrs. To be submitted.
4.0	**QUALITY DOSSIER:**			
4.1	Document Review & Issuance of IRN	Review of Quality Dossier along with Index & software licence.	Customer Hold Point (CHP)	
N O T E	A) STATUTORY REQUIREMENTS SHALL BE COMPLIED BY THE CONTRACTOR. B) THIS DOCUMENT IS INDICATIVE & IS WITH MINIMUM QUALITY CHECKS. ANY ADDITIONAL CHECKS/QUALITY REQUIREMENT (INCLUDING ADDITIONAL TYPE/ DESIGN VALIDATION TESTS) AS PER TECHNICAL SPECIFICATIONS/ PO/ CONTRACT REQUIREMENT, SHALL BE DISCUSSED & ADDED IN THE MANUFACTURING QUALITY PLAN. C)TATA POWER / ITS REP IDENTIFICATION STAMP ON MATERIALS SHALL BE PRESERVED, IF REQD, SAME SHALL BE TRANSFERRED BY TATA POWER / ITS REP ONLY FOR MATERIAL TRACEBILITY. D) INSPECTION & TEST ACTIVITIES SHALL BE WITTNESSED BY CLIENT AND IS HOLD POINT (AT THE DISCRETION OF TATA POWER) E) MANUFACTURER SHALL PREPARE AND SUBMIT COMPLETE MANUFACTURING QUALITY PLAN IN PRESCRIBED FORMAT OR THEIR REGULAR FORMAT INDICATING THEIR REGULAR PRACTICES, TAKING CARE OF MINIMUM REQUIREMENT AS INDICATED ABOVE. F) INSPECTION OF THE MAINTAINCE SPARES SHALL BE OFFERED ALONG WITH THE MAIN SUPPLY AS PER THE INSPECTION STAGES 1 TO 4. G) CALIBRATION CERTIFICATES OF THE EQUIPMENT USED FOR TESTING SHALL BE PROVIDED FOR REVIEW. H) AS PER SPECIFICATION PROPER PAINTING, PACKING & PRESHIPMENT CHECKS SHALL BE ENSURED BY SUPPLIER BEFORE SHIPMENT TO AVOID ANY TRANSIT DAMAGE. I) TATA POWER RESERVES THE RIGHT TO DEMAND / VERIFY/ AUDIT/ WITNESS ANY OF THE CHECK POINTS MENTIONED IN THE SCOPE OF SUPPLIER.			
0	FIRST ISSUE	Shruti Marathe	C R Bhonslay	S. Simlai
Rev. No	**Reason for Revision**	**Prepared By & Date**	**Checked By & Date**	**Approved By & Date**

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SECTION C- GCC & SCC

TATA POWER

GCC-Supply (Annexure to Tender Documents)

CONFIDENTIAL

The Tata Power Company Limited is hereunder referred to as the "Purchaser" or "Company". The person, firm or company selling the goods, the subject of this purchase order is referred to as "Vendor" or "Contractor". The subject of this purchase order is hereinafter referred to as the "Material(s)"or "Goods".

The Contract shall mean the contract as derived from the following:

1. Purchase Order (with 'Commercial Notes' and Annexures to the Purchase Order referred thereon)
2. Technical Specifications.
3. General Terms & Conditions

The documents including all reference document (s) and Annexures forming the Contract are to be read together as a whole and are to be taken as mutually explanatory.

1. Price:

Unless otherwise specifically stipulated, the price shall be firm and shall not be subject to escalation for any reason till the validity of this Contract.

Unless otherwise specifically stipulated, the price shall be inclusive of road/ rail worthy water-proof packing & forwarding charges up to effecting delivery at FOT/ FOR despatch point, GST and shall also be inclusive of inland freight, terminal taxes and entry taxes as leviable on the transportation or entry of goods into any local area limits pursuant to the Contact.

2. Taxes and Duties:

2.1 The Contract Price shall be inclusive of all taxes, duties, including but not limited to GST or any local taxes, levies imposed by State/Central/Local governments

2.2 Taxes as mentioned in the Contract Price or Price Schedule shall be paid to the contractor subject to the Contractor complying with all the statutory requirements and furnishing the relevant documents including error free invoices containing detailed break-up of the taxes

2.3 However the payment of GST or local levies shall be restricted to the total amount as indicated in the price schedule.

2.4 Any duties, levies or taxes not mentioned in Contract Price or Price Schedule but applicable as per any statute (s) shall be deemed to be included in the Contract price and shall be to the account of the Contractor.

2.5 Any statutory variation in duties, levies or taxes if applicable and specified in this Contract till the scheduled date for supply of Goods and limited to direct invoices of the Contractor shall be to the account of Purchaser. The Contractor shall have the obligation to provide the necessary documentary evidence / supporting by way of gazetted notifications etc. to prove the change in such levies or taxes between the due date of submission of the Bid and the scheduled date of supply of goods to claim the difference.

2.6 The Contractor shall pass on to the Purchaser all the benefits of either reduction in tax rates, exemptions, concessions, rebate, set off, credits etc. or introduction of new tax rates exemptions, concessions, rebate, set off, credits etc. pertaining to all taxes, duties, imposts, fees and levies in respect of the supplies of Goods or performance of obligations under the contract. This would specifically include reduction of tax rates as a result of statutory changes or judicial rulings.

2.7 Any other taxes, levies and duties not mentioned in Contract Price or Price Schedule but applicable as per any statute (s) or introduction (omission) of new taxes, levies and duties shall be deemed to be included in the Contract Price and shall be to the account of the Contractor.

2.8 For facilitating availment of a credit, set-off, rebate, drawback or like benefit available to the Purchaser, the Contractor will facilitate the Purchaser by providing the necessary documentary and/or procedural support. In any process of assessment or re-assessment, of taxes payable by the Purchaser. Wherever expressly agreed the purchaser would provide the statutory form 'C' to the seller for availing the concessional rate of Central sales tax.

2.9 The Contractor shall bear and pay all the costs, liabilities, levies, interest, penalties in respect of non-compliances of any legal requirements as per various statutory provisions. The contractor shall keep the owner indemnified at all times from any tax liability, interest, penalties or assessments that may be imposed by the statutory authorities for non-compliances or non-observation of any statutory requirements by the Contractor.

2.10 Purchaser shall pay the invoices to the Vendor after necessary deductions as prescribed under the applicable law, income – tax or other

deductions under the State Tax laws as may be applicable to the Contract.

3 Packing details:

Packing details: The material must be packed in suitable packing to suit the mode of transport and to ensure its safe receipt at point of delivery. Any damage to material noticed at the time of delivery at site, due to improper packing or any other reason whatsoever shall be the responsibility of the Vendor. Such damaged goods shall be replaced within 14 days from intimation from the Purchaser.

4 Transportation and Unloading at Site:

The Vendor shall deliver the Material(s) at site/ Stores as per the delivery address specified in the Purchase order. The unloading at delivery shall be organised by the Purchaser unless otherwise specified. The receipt of the material/ equipment is subject to inspection and rejection if Material(s) is found unsatisfactory or any of the clauses under this purchase order are violated.

5 Insurance:

Unless otherwise specified, Purchaser will be responsible to obtain transit insurance for the Material(s). The Vendor shall intimate the Order Manager (as mentioned in the Purchase Order) along with Invoice, packing list, the Railway Receipt/Truck or Lorry Receipt etc. immediately after the consignment is booked, at the e-mail id mentioned in the Purchase order.

6 Payment Terms:

100% payment shall be made within 60 days from the receipt and acceptance of the material at the Consignee Stores/ Site/ Location as per the Contractual terms and conditions herein.

7 Bills and invoice:

The tax invoices should contain the details to comply with the GST Law. The supplier shall:

i) Furnish (electronically) and communicate to the Owner, the details of Goods or Services supplied by the 10th of the month succeeding the said tax period,
ii) Upon discovery of any discrepancy, rectify it and shall pay the tax and interest thereof,
iii) Furnish the returns (electronically), for the inward and outward supplies of Goods and/or Services, before the specified dates as per the GST Law,
iv) Communicate the tax paid, credits etc. as and when credited.
v) The Invoice should clearly state the description of the goods, quantity, sale price, tax %, and tax amount;
vi) The Invoice should be signed by an Authorized Signatory.

Bills/Invoices in the name of The Tata Power Company Ltd. with packing lists in triplicate shall be forwarded along with the equipment.

Contractor to furnish GST Registration no. in all invoices as well as Purchaser's (Tata Power's) GST no.

8 Transfer of Title and risk:

The transfer of property and risk of Material(s) shall be deemed to take place as follows:

a. For delivery F.O.R. or F.O.T. despatch point: Transfer of property on handing over the Material(s) to the carrier against receipt of clean Railway Receipt/Truck or Lorry Receipt and such receipt having been handed over to Purchaser. However, the risk of loss shall pass to the Purchaser on delivery of goods at the specified destination.

b. In case the Material(s) are procured by the Vendor from sub-vendors on receipt of duly endorsed documents of title to the goods.

9 Contract Performance Bank Guarantee (In case applicable):

9.1 The Vendor shall within 15 days of issue of this Purchase Order furnish an unconditional irrevocable bank guarantee duly stamped and strictly as per the prescribed format of the Purchaser from any nationalized bank or any scheduled bank having a branch in Mumbai and approved by the Purchaser for a sum equivalent to 10% of the Total value of Order valid for a period not less than 6 months from the expiry of the Warranty period.

9.2 Irrespective of the performance demonstrated as part of the Factory Acceptance Tests Take-over tests / Performance Tests etc, the Purchaser may call for re-validation of performance of the system during the performance guarantee period by conducting fresh performance tests if in its opinion, the

system is not able to deliver the designed performances based on its operational performance results. If the equipment fails to prove the performance during such performance tests, the Purchaser may allow the Vendor to either rectify the system by addition / modification of equipment etc at the Vendor's costs & risk to restore the performance levels. Failure to rectify the system to achieve the designed performance levels may result in imposition of penalties including revocation of the Performance Bank Guarantee and forfeiture of the entire amount under the Performance Guarantee.

9.3 In case the Vendor fails to furnish the requisite Bank Guarantee as stipulated above, then the Company shall have the option to terminate the contract besides other contractual remedies.

10 Price reduction:

10.1 The Vendor agrees that time of supply of Material(s) is of prime importance.
If the Vendor fails to supply Material(s) before the respective scheduled / fixed date for supply. Company may without prejudice to any other right or remedy available to the Company: -

10.1.1 Recover from the Vendor ascertained and agreed, genuine pre-estimate liquidated damages, and not by way of penalty, a sum equivalent to 1% (of total value of order) per week or part thereof for each week's delay, beyond the scheduled supply date each subject to maximum of 10% of the total order value, even though the Company may accept delay in supply after the expiry of the scheduled supply date. The Company may, at its discretion, set off the aforesaid amounts from any other amounts owed by the Company to the Vendor or recover such amounts in other manner as may be permissible under applicable laws.

10.1.2 Arrange to get supply from elsewhere on account and at the sole risk of the Vendor, such decision of the Company being final and binding on the Vendor; or

10.1.3 Terminate the contract or a portion of supply of the supply work thereof, and if so desired, arrange for the supply in default by the Vendor to be attained from elsewhere at the sole risks and costs of the Vendor.

10.2 Liquidated damages for performance shortfall (if applicable) shall be specified in the Technical Specifications.

10.3 The Liquidated Damages referred in this clause 10 may be recovered by the Company from the Vendor as set off against any monies owed by the Company to the Vendor or in any other manner permissible under applicable laws.

11 Warranties:

11.1 Materials and Workmanship: Vendor shall fully warrant that all the stores, equipment and component supplied under the order shall be new and of first class quality according to the specifications and shall be free from defects (even concealed fault, deficiency in design, materials and workmanship).

11.2 Should any defects be noticed in design, material and/or workmanship within 12 months after the Material(s) or any portion thereof as the case may be have been commissioned or for 24 months from the date of delivery, whichever period concludes earlier. Purchaser shall inform Vendor and Vendor shall immediately on receipt of such intimation, depute their personnel within 7 days to investigate the causes of defects and arrange rectification/ replacement/modification of the defective equipment at site, without any cost to Purchaser within a reasonable period. If the Vendor fails to take proper corrective action to repair/replace defects satisfactorily within a reasonable period, Purchaser shall be free to take such corrective action as may be deemed necessary at Vendor's risk and cost after giving notice to the Vendor, including arranging supply of the Goods from elsewhere at the sole risk and cost of the Vendor.

11.3 In case defects are of such nature that equipment shall have to be taken to Vendor's work for rectification etc., Vendor shall take the equipment at his costs after giving necessary undertaking or security as may be required by Purchaser. After repair Vendor shall deliver the equipment at site on freight paid basis. Any taxes applicable in relation to this repair shall be to the Vendor's account. All risks in transit to and fro shall be borne by the Vendor.

11.4 Equipment or spare parts thereof replaced shall have further warranty for a period of 12 months from the date of acceptance.

12 Quality, Testing, inspection, installation:

12.1 All Material(s) supplied under this Contract shall be new and unused.

12.2 Wherever a specific Quality Assurance Plan is provided with the Request for Quotation (RFQ) or agreed as part of the commercial/ technical discussions, the same shall be binding on the Vendor.

12.3 The material shall be inspected

a. At consignee end by Purchaser.

b. At factory premise of the Vendor/ sub-vendor by Purchaser or third party duly nominated by Purchaser. The Vendor shall extend all necessary co-operation to Purchaser/ third party inspector carrying out the inspection. The Inspector(s) shall have the right to carry out the inspection or testing, which will include inspection and testing of the raw materials at manufacturers shop, at fabricators shop and at the time of actual despatch before and/or after completion of packing.

12.4 The Vendor will inform Purchaser at least eight (8) days in advance of the exact place, date and time of tendering the Material(s) for required inspection and provide free access to the Inspector(s) during normal working hours at Vendor's or his/ its sub-Suppliers works, and place at the disposal of the Inspector(s) all useful means for undertaking the Inspection, checking the results of tests performed, marking the Material(s), getting additional tests conducted and final stamping of the Material(s).

12.5 Even if the inspection and tests are fully carried out, the Vendor shall not be absolved from its responsibilities to ensure that the Material(s), raw materials, components and other inputs are supplied strictly to conform and comply with all the requirements of the Contract at all stages, whether during manufacture and fabrication, or at the time of Delivery as on arrival at site and after its erection or start up or consumption, and during the defect liability period. The inspections and tests are merely intended to prima facie satisfy Purchaser that the Material(s) and the parts and components comply with the requirements of the Contract.

12.6 *All costs associated with the inspection shall be included in cost of Material(s).*

12.7 Original material test certificate/ performance test certificate/ fitment certificate/ test reports etc. relevant/ applicable as per the specifications/ standards shall be dispatched along with the material supply failing which the material may be rejected.

13 Rejection:

13.1 Rejected goods shall be removed and replaced within 14 days of the date of communication of rejection.

13.2 Claim in respect of breakage/shortages in any cases shall be referred on the Vendor within ninety (90) days from the date of receipt of Goods by the Purchaser which shall be replaced/made good by the Vendor at his own cost. All risk of loss or damage to the material shall be upon the Vendor till it is delivered to the purchaser/consignee.

14 **General Indemnity:**

The Vendor shall indemnify and keep the Purchaser indemnified from and against any and all claims, costs, liabilities (financial), litigations, compensations, judgments, expenses or damages (including attorney's fees and other related expenses) arising out of any breach or alleged breach of any of the conditions of this Contract, performance of the obligations hereunder, or any representation or misrepresentation made by the Vendor or any third party with regard to the subject of this Contract.

15 **Indemnity against IPR:**

The equipment, system, drawings, and other materials that shall be supplied against the order will become the Purchaser's property. Without limitation of any liability of whatsoever nature, the Purchaser shall be indemnified and kept indemnified against any claim for infringement or breach of any of the statues, rules & regulations by the use of or sale of any article or material supplied by the Vendor. The indemnity shall include any infringement of patent, trade mark, design, copyright or other property rights whether in Country of Origin, or elsewhere resulting from the Vendor's design, manufacture, use, supply or re-supply & would also cover use or sale of any article or material supplied by the Vendor to the Purchaser under the Purchase Order. The Indemnity shall cover any claim/action taken by a third party either directly against the Purchaser or any claim/action made against the Vendor & where under the Purchaser is made liable. The

Indemnity shall be for losses, damages, and costs including litigation costs, attorney fees etc incurred by the Purchaser in relation to the Purchase Order.

16 Latent Defects Liability period (if applicable):

Notwithstanding the inspections, acceptance tests, quality checks etc carried out by the Vendor and witnessed/accepted by the Purchaser, the Vendor shall further warrant the equipment for any latent defects in its design, material or workmanship against the specifications set forth and shall make good any such defects by way of repair or replacement of the part or whole of the defective product at its own cost & risks as and when such latent defects are observed and intimated by the Purchaser and intimated to the Vendor within 36 months of completion of warranty period.

17 Force Majeure:

17.1 In the event of either party being rendered unable by force majeure to perform any obligation required to be performed by it under this Contract the relative obligation of the party affected by such force majeure shall, after notice under this articles be suspended for the period during which such cause lasts. The term 'Force Majeure' as employed herein shall mean acts of God, wars (declared or undeclared), riots or civil commotion, fire, floods, and acts and regulations of the Government of India or State Government or any of the statutory agencies. Both the party shall pay to the other party, the amount payable upon the date of the occurrence of such force majeure.

17.2 Upon the occurrence of such cause and upon its termination, the party alleging that it has been rendered unable as aforesaid, thereby shall notify the other party in writing immediately but not later than twenty four (24) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of the claims.

17.3 During the period, the obligations of the parties are suspended by force majeure, the contractor shall not be entitled to payment of any rate.

17.4 In the event of the force majeure conditions continuing or reasonably expected to continue for a period more than thirty (30) days, Purchaser shall have the option of terminating the contract by giving seven (7) days notice thereof to the contractor.

18 Variation:

Except for any provisions in this Purchase Order, any change /modification to the terms and conditions of this Order can be issued only by Purchaser or with the prior written approval from Purchaser.

19 Termination

19.1 The Contract shall be deemed to be terminated on completion of delivery of Material(s)

19.2 Termination of Default by Vendor:
Purchaser may terminate the contract at any time if the Vendor fails to carry out any of his obligations including timely delivery under this Contract. Prior to termination, the Vendor shall be advised in writing of the causes of unsatisfactory performance to be improved upon 15 days of the receipt of notice. In case, if the Vendor fails to bring about the improvement to the satisfaction of the Purchaser, then the order shall be terminated.

19.3 Without prejudice to the rights and remedies available to Purchaser, Purchaser may terminate the Contract or part thereof with immediate effect with written notice to the Vendor if,:

19.3.1 The Vendor becomes bankrupt or goes into liquidation.

19.3.2 The Vendor makes a general assignment for the benefit of creditors.

19.3.3 A receiver is appointed for any substantial property owned by the Vendor.

19.3.4 The Vendor has misrepresented to Purchaser, acting on which misrepresentation Purchaser has placed the Purchase Order on the Vendor.

The Vendor/ Contractor shall not be entitled to any further payment under the Contract if the Contract is terminated. If the order is terminated under clause 19.2 and 19.3, the Vendor shall not be entitled to any further payment, except that, if Purchaser completes the supply of Material(s) and the costs of completion are less than the Total Order value, the Purchaser shall pay Vendor an amount properly allocable to supply of Material(s) fully performed by Vendor prior to termination for which payment was not made to Vendor. In case, the cost of completion of Material(s) exceed the total Order value, the additional cost incurred by Purchaser for such completion shall be paid by the Vendor.

19.4 Purchaser shall be entitled to terminate the Contract at it's convenience, at any time by giving thirty (30) Days prior notice to the Contractor. Such notice of termination shall specify that termination is for Companies convenience and the date upon which such termination becomes effective. Upon receipt of such notice, the Contractor shall proceed as follows:

19.4.1 cease all further work, except for such work as may be necessary and instructed by the Company/ Company's representative for the purpose of protecting those parts of the supplies already manufactured;

19.4.2 stop all further sub-contracting or purchasing activity, and terminate Sub-contracts;

19.4.3 handover all Documents, equipment, materials and spares relating to the supply of goods prepared by the Contractor or procured from other sources up to the date of termination for which the Contractor has received payment equivalent to the value thereof; and

19.4.4 handover those parts of the supplies manufactured by the Contractor up to the date of termination.

Upon termination pursuant to clause 19.4, the Vendor shall be entitled to be paid the full value on the Material(s) delivered in accordance with the Contract.

19.5 The Contractor shall not be released from any of his obligations or liabilities accrued under the Contract on termination. For the avoidance of doubt, the termination of the Contract in accordance with this clause shall neither relieve the Contractor of his accrued obligations for Warranty or his accrued liability to pay (liquidated) damages for Delay nor shall entitle him to reduce the value of Performance Security.

20 Sub letting and assignment:

The contractor shall not without prior consent in writing of the Purchaser, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever, provided nevertheless that any such consent shall not relieve the contractor from any obligation, duty or responsibility under the contract.

21 **Dispute Resolution**:

Dispute or differences arising out or relating to this Order shall be resolved amicably by the parties. Failing such amicable resolution of dispute / differences either party may refer the matter to arbitration of a Sole Arbitrator to be appointed jointly by both the parties. The award of the Arbitrator shall be final, binding and conclusive on the parties. The venue for arbitration shall be Mumbai. The Arbitration proceedings will be governed and regulated by the provisions of Indian Arbitration and Conciliation Act, 1996 as amended from time to time and the rules framed there under.

22 Governing laws

This Contract shall be construed in accordance with and governed by the Laws of India without giving effect to any principle of conflict of law.

23 Jurisdiction

This Contract and the transaction contemplated herein shall be subject to the exclusive jurisdiction of the competent Courts in Mumbai only.

24 Limitation of Liability

Notwithstanding anything contained in the Contract, the Contractor's aggregate liability under this Contract shall be limited 100% of the Total order value. This shall however, exclude liability arising pursuant to clause 2.8- tax indemnity, clause 14- General Indemnity, clause 15- Indemnity against IPR, clause 25 – Confidentiality and liabilities arising due to wilful misconduct, gross negligence, third party claims and corrupt acts attributable to the Vendor.

25 Confidentiality:

The Vendor shall use the Confidential Information of the Purchaser only in furtherance of this Contract and shall not transfer or otherwise disclose the Confidential Information to any third party. The Vendor shall (i) give access to such Confidential Information solely to those employees with a need to have access thereto; and (ii) take the same security precautions to protect against disclosure or unauthorized use of such Confidential Information that the party takes with its own confidential information but, in no

event, shall a party apply less than a reasonable standard of care to prevent such disclosure or unauthorized use.

26 Consequential Damages:

Unless otherwise specified, neither Party shall be responsible for and nor shall be liable to the other Party for indirect/consequential losses and damages suffered by such Party including for loss of use, loss of profit whether such liability or claims are based upon any negligence on the part of the other Party or its employees in connection with the performance of the Purchase Order.

27 New Legislation (The Micro, Small and Medium Enterprise Development Act 2006)

a. This Act has been enacted and made effective from 2nd October 2006. The Interest on Delayed Payments to Small Scale and Ancillary Industrial Undertaking Act, 1993 is repealed.

b. Vendor is requested to inform the purchaser if vendor fall under The Micro, Small and Medium Enterprises Development Act, 2006 legislation and provide the purchaser, registration number and date to enable purchaser to take necessary care. The vendors are also requested to mention the same on their invoice / bill.

28 Relation between parties:

The Purchase Order shall be entered into on a principal-to-principal basis only. The Purchase order shall not be construed as a partnership or an association of persons. There is no agent and principal relationship between the parties. Each party shall be responsible for its own conduct. The Vendor shall ensure at all times that all the work carried out under this contract either by its own person or through any of its sub-Vendors shall be always done under its own direct supervision.

29 Environment / ISO 14001 Certification:

The Vendor to confirm whether their organization is ISO 14001 certified. If not, the Vendor must certify that the handling, use and disposal of their product / by-products conform to practices consistent with sound environmental management and local statutes. The Vendor shall ensure that all the wastes are disposed in environmental friendly way with strict compliance to applicable laws including adherence to MoEF guidelines with respect to disposal of batteries, lead waste, copper cables, ash, waste oil, e-waste etc which shall be disposed through MoEF approved parties only. The Vendor shall also be responsible to collect and recycle all the e-waste generated at the end of the product life cycle at its own costs and risks as per the MoEF guidelines/ orders.

30 Tata Code of Conduct

The Purchaser abides by the Tata Code of Conduct in all its dealing with stake holders and the same shall be binding on the Purchaser and the Vendor for dealings under this Purchase Order. A copy of the Tata Code of Conduct is available at our website: http://www.tatapower.com/aboutus/code-of-conduct.aspx. The Vendor is requested to bring any concerns regarding this to the notice of our Chief Ethics Officer on the e-mail ID: cecounsellor@tatapower.com.

31 Responsible Supply Chain Management:

The Purchaser is committed for a cleaner environment and respect of Human rights through its Responsible Supply Chain Management policy. The Vendor is required to comply with all the environment & Human rights related laws, including emission norms, Labour and environmental regulations. The Purchaser encourages its Vendors/ Contractors/ Business partners to pay more attention to green design, green supply, green production, green logistics and green packaging in performing their business obligations.

The Vendor is required to abide by the Tata Power Corporate Environment policy, Energy Conservation and Corporate Sustainability Policy.

A copy of the Responsible Supply Chain Management Policy along with Environment policy, Energy Conservation policy, Sustainability policy, Health & Safety policy and Human Rights policy is available at website: http://www.tatapower.com/sustainability/policies.aspx.

Vendor/Bidder is required to completely fill the attached "Supplier Sustainability Questionnaire" in support of their Green Supply Chain Management initiatives and submit the same with their offer.

The Owner recognizes that diversity in the workplace positively impacts business. The Owner is committed to help people from SC/ST background either by helping them to become entrepreneurs or by engaging workforce from SC/ST community under the contracts agreed herein. To encourage engaging SC/ST community, the owner may consider on the merit to incentivize the Contractor by paying additional 1% of the service contract portion if the number of SC/ST workforce engaged in the contract exceeds 30% of the total deployed strength and 2%, if the strength goes beyond 50%. While the Contractor will assist the workforce so engaged to become self-reliant in meeting the work expectation, the Owner may also volunteer its training resources to the extent possible to improve their employability. The Contractor shall maintain the proper documentation of such category of the workforce engaged and the owner may consider to pay the incentive after its verification.

The Owner may also consider extending price preference of 5% in the bid evaluation for an order value up to Rs.50 Lacs, provided the company is owned by a person from SC/ST community having minimum 50% holding in the company.

32 Vendor rating

You are requested to ensure compliance to the terms of the individual orders with regards to timely delivery, provision of all applicable documents / challans / test certificate, quality of the material etc. Your performance with respect to the said factors will be taken into consideration for future business.

33 Vendor Feedback:

33.1 In this dealing Vendors feedback is important for the purchaser to improve its processes. If vendor have to report any grievance, problem or require any clarification, information, vendor is requested to contact purchaser at email ID: CC_CUSTOMERFEEDBACK@tatapower.com

33.2 Vendor is requested to ensure compliance to the terms of the individual orders with regards to timely delivery, provision of all applicable documents / challans / test certificate, quality of the material etc. Vendor performance with respect to the said factors will be taken into consideration for future business.

34 Non-Waiver:

Failure of Purchaser or its representatives to insist upon adherence to any of the terms or conditions incorporated in the Contract or failure or delay to exercise any right or remedies herein or by law accruing, or failure to promptly notify the Vendor in the event of breach or the acceptance of or the payment of any Material(s) hereunder or approval of any design or Material(s) shall not release the Vendor and shall not be deemed a waiver of any right of Purchaser to insist upon the strict performance thereof or of any of its rights or remedies as to any such Material(s) regardless of when the Material(s) are shipped, received or accepted not shall any purported oral modification or revisions of the Contract by Purchaser or its representative(s) act as waiver of the terms hereof.

35 **Repeat Order**:

Purchaser may place the repeat order for 100% of ordered quantities within a span of 6 months from the date of issue of this Purchase Order & Vendor shall execute it at same rates, terms and conditions.

36 Severability

If any provision of this Contract is invalid, unenforceable or prohibited by law, this Contract shall be considered divisible as to such provision and such provision shall be inoperative and shall not be part of the consideration moving from any Party hereto to the others, and the remainder of this Contract shall be valid, binding and of like effect as though such provision was not included herein.

The Tata Power Company Limited is hereunder referred to as the "Owner" or "Company". The person, firm or company offering the services, the subject of this order is referred to as "Contractor". The subject of this order is hereinafter referred to as the "Work".
"Sub-Contractor" means any person named in the Contract as a Sub-contractor, sub-vendor, manufacturer or supplier for a part of the Works or any person to whom a part of the Works has been subcontracted and the legal successors in title to such Person, but not any assignee of such Person.

The Contract shall mean the contract as derived from the following:

1. Work Order (with 'Commercial Notes' and Annexures to the Work Order referred thereon)
2. Scope of Work.
3. General Terms & Conditions - Service

The documents including all reference document (s) and Annexures forming the Contract are to be read together as a whole and are to be taken as mutually explanatory, provided however, in the event of any inconsistency or discrepancy between the aforementioned documents, the order of precedence in interpretation of the documents shall be as set out above. For the avoidance of doubt, it is clarified that the terms set forth in the Work Order (with 'Commercial Notes' and Annexures to the Work Order referred thereon) shall take precedence over the terms set out in the Scope of Work, which shall in turn take precedence of the terms set out in the General Terms & Conditions – Service.

1. Contractor's obligation:

1.1 Contractor warrants that it is a competent, qualified and experienced contractor, equipped, organised and financed to perform and complete the services in the operating area in an efficient and professional manner and capable of meeting all the requirements of the Contract.

1.2 The Contractor has the overall responsibility of executing the contract, conducting Planning, Job Scheduling, Maintenance Planning, Maintenance Job Scheduling, executing the Work and maintenance jobs as per the Scope of work & schedule.

1.3 Except to the extent that it may be legally or physically impossible or create a hazard to safety, the Contractor shall comply with the Owner's representative(s) instructions and directions on all matters relating to the Work.

1.4 Contractor shall at all times have full responsibility for control of the Equipment and for the direction and supervision of operations being carried out under the Contract.

1.5 In the performance of the Work, Contractor shall be and act as an independent Contractor fully responsible and accountable for the proper execution of its responsibilities, obligations and liabilities under this Contract and for its own acts and the acts of its Sub-Contractors and the Personnel. Owner's supervision, examination or inspection of the (performance of the) Work or omission to carry out the same shall not be construed in any manner whatsoever as relieving Contractor from its responsibilities, obligations or liabilities under this Contract.

1.6 Contractor shall submit list of tools & tackles with details of make, year of manufacturing, valid certification to the Project Manager/ User for their approval.

Project Manager may during the execution of project inspect & verify that the tools & tackles are as per the qualification requirements approved by him and will have right to seek replacements in case of any discrepancies. The Contractor shall always comply with such directives.

1.7 Contractor shall engage Tata Power Skill Development Institute (TPSDI) certified labour force at the site for execution of the job. Requirement & fees for TPSDI certification shall be as per Company Policy.

1.8 Contractor shall take full responsibility for the protection and security of Owner's materials and equipment while such materials and equipment are temporarily stored in Contractor's facility or otherwise in Contractor's custody.

1.9 All notices, instructions, information, and other communications given by the Contractor to Owner under the Contract shall be given to the Order Manager/ Owner's representative, except as otherwise provided for in this Contract.

1.10 The Contractor shall make its own arrangements for movement of personnel and equipment, within and outside the sites / units / offices at the various locations covered by the Contract.

1.11 The Contractor shall acquire in its name all permits, approvals, and/or licenses from all local, state, or national government and other statutory authorities and/or public service undertakings that are necessary for the performance of the Contract.

1.12 Neither the Contractor nor its personnel shall during the term of this Contract, engage in any business or professional activities in India/abroad which would conflict with the activities assigned to them under this Contract.

2. Service Warranties:

Contractor warrants that all services performed for or on behalf of Owner will be performed in a competent,

workmanlike manner and shall be free from faults and defects. Said warranties shall be in addition to any warranties of additional scope given by Contractor to Owner. None of said warranties and no other implied or express warranties shall be deemed is claimed or excluded unless evidenced by a change notice or revision issued and signed by Owner's authorized representative.

3. Compliance of Local Laws:

Contractor shall be responsible and shall comply with the provision of all the Statutory Acts Applicable. Special attention of the Contractor is drawn towards the compliance of provision of the following statues: (along with the latest amendments/additions, as applicable):

a) The Child Labour (Prohibition and Regulation) ACT, 1986.
b) The Contract Labour (Regulation and Abolition) ACT, 1970.
c) The Employee's Pension Scheme, 1995.
d) The Employee's Provident Funds and miscellaneous provisions Act, 1952.
e) The Employees State Insurance Act, 1948.
f) The Equal Remuneration Act, 1976.
g) The Industrial Disputes Act, 1947.
h) The Maternity Benefit Act, 1961.
i) The Minimum Wages Act, 1948.
j) The Payment of Bonus Act, 1965
k) The Payment of Gratuity Act, 1972.
l) The Payment of Wages Act, 1936.
m) The Shops & Establishment Act, 1954.
n) The Workmen's Compensation Act, 1923.
o) The Employer's Liability Act, 1938.
p) and any other applicable statutory act

Site Specific requirements shall be as Annexure at I. The compliance to these Site Specific requirements shall not absolve the Contractor of its obligation to comply with the Owner's Contractor Safety Management Policy.

4. Owner's Obligation:

4.1 The order manager (As specified in the 'Commercial Notes') shall have the authority to represent Owner on all day-to-day matters relating to the Contract or arising from the Contract. All notices, instructions, orders, certificates, approvals, and all other communications under the Contract shall be given by the order manager, except as otherwise provided for in this Contract. The order manager may appoint the Engineer-In-Charges for different areas for monitoring the work progress, inspections and signing of bills.

4.2 Owner shall ensure the availability of site access, all information and/or data to be arranged/ supplied by Owner to the Contractor for execution of the Work . The terms on which the Contractor shall be allowed access to the site shall be specified by the Owner prior to commencement of the execution of the Work and thereafter shall be governed in accordance with such policies as the Owner may provide in writing to the Contractor from time to time.

5. **Contractor's/ Sub-contractor's employees**:

5.1 The Contractor shall engage appropriately qualified persons to provide the services with the prior approval of Owner. Owner may withhold such approval for any reason whatsoever.

5.2 The Contractor hereby represents and warrants that:

i) the personnel are duly qualified, and are, and will remain, sufficiently qualified, careful, skilful, diligent and efficient to provide the services to Owner; and
ii) the Services will be rendered carefully, skilfully, diligently and efficiently, and to the professional standard reasonably expected by Owner of a contractor qualified and experienced in providing services substantially the same as the Services.

5.3 The Contractor must ensure that the Contractor's personnel conduct themselves in a proper manner and comply with the procedures and all policies, regulations and directives of Owner including any occupational, health and safety policies and the relevant prevailing laws and regulations in the Country of operations and specifically in the area where Work is being executed.

5.4 Owner may inform the Contractor to immediately remove Contractor's personnel from the relevant premises in the event of misconduct or incompetence on the part of the Personnel. The Contractor shall at all times remain liable for all acts and/or omissions of its Personnel.

5.5 It is made clear that no relationship of Owner and employee is created between Owner and the Contractor's resident engineers, employees and no claim for employment of any such personnel shall be tenable or entertained.

6. Title of Property:

6.1 Unless otherwise provided in this order or agreed to in writing, property of every description including but not limited to all tooling, tools, equipment and material furnished or made available to Contractor, title to which is

in Owner, and any replacement thereof shall be and remain the property of Owner. Such property other than material shall not be modified without the written consent of Owner. Such property shall be plainly marked or otherwise adequately identified by Contractor as being owned by Owner and shall be safely stored separately and apart from Contractor's property.

6.2 Contractor shall not use such property except for performance of work hereunder or as authorized in writing by Owner. Such property while in Contractor's possession or control shall be listed in writing and kept in good condition, shall be held at Contractor's risk, and shall be kept insured by Contractor, at its expense, in an amount equal to the replacement cost with loss payable to Owner. To the extent such property is not material consumed in the performance of this order, it shall be subject to inspection and removal by Owner and Owner shall have the right of entry for such purposes without any additional liability whatsoever to Contractor. As and when directed by Owner, Contractor shall disclose the location of such property, prepare it for shipment and ship it to Owner in as good condition as originally received by Contractor, reasonable wear and tear excepted.

7. Work Completion schedule:

Contractor shall plan and execute the Work in accordance with a detailed schedule mutually agreed upon by the Parties (Owner and Contractor).

8. Contract Price and Payment:

8.1 The Contract Price shall be a firm & fixed Contract Value for the Work inclusive of all the taxes, levies & duties and shall remain firm till the validity of this contract.

8.2 Unless Specifically stated elsewhere in the contract, the Contractor is solely liable for payment of , and warrants that it will pay, or ensure the payment of all taxes imposed, assessment made in relation to the Work.

8.3 An amount as stated in the table below shall be retained towards Contractor's safety performance against every RA bill:

Contract Value	Retention Amount (%)
Upto Rs. 10 lakhs	2.5
Above Rs. 10 lakhs and below Rs. 50 lakhs	2
Above 50 lakhs and upto Rs. 10 Crores	1.5
Above Rs. 10 Crores	1

The above mentioned safety retention shall be over and above any other retentions/ deferred payments as may have been specifically agreed in the Contract.

8.4 For Contract Price Rs. 1 crores or above and Contract Completion Schedule 12 months or more, the above safety retention will be released half yearly against the Safety Performance Score (methodology for evaluation enumerated in the Safety Terms & Conditions attached as Appendix to this General Terms & Condition) which will be evaluated by the Order Manager every month. For all other contracts, the above said safety retention shall be released along with the final settlement only at the end of the contract period.

8.5 The Owner shall have the right to stop any work which in its opinion is not meeting the safety standards/ guidelines of the Owner and good engineering practice. The Contractor shall not be eligible for and shall not be granted any extension in Completion Schedule due to such stoppage of work by the Owner.

8.6 The above retention towards safety shall not absolve the Contractor of its liabilities including statutory liabilities towards safety violations, injury or death (whether by accident or otherwise). An amount between Rs. 5 to 50 lakhs as deemed appropriate by Owner's appointed Committee for incident investigation and/ or as determined by statutory authorities (whichever higher), will be payable by the Contractor in case of such severe incidents of injury leading to loss of property or partial/ permanent disablement (e.g. loss of limb/s, vision etc.) or death.

8.7 Notwithstanding anything else stated in the Contract, the Contract shall be liable for termination without any notice and without recourse to Owner in case of three (3) or more severe safety violations. There shall be no termination fees/ compensation payable to Contractor for such termination.

8.8 In case the Contractor achieves 100% on the Safety Performance Score, the Contractor shall be awarded a discretionary bonus of 1% of invoiced value subject to a maximum of Rs. 50 lakhs towards Safety Performance.

8.9 Payment shall be released within 60 days of submission of error free invoice with supporting documents duly certified by the Order Manager/ Engineer-in-Charge after deducting taxes at source as prescribed under the applicable law, income – tax or other deductions under the state value added tax laws . If such payment release

day falls on a holiday of Owner, payment will be released on the next working day. Against deduction of statutory taxes, tax deduction certificates where ever applicable shall be issued as per the applicable provisions of the statute. The Order Manager may recover any amount wrongly paid in excess in any previous bills certified by him.

8.10 *Mode of Payment*: All payments shall be made direct to the Contractor or his authorized representative in the shape of RTGS or Electronics Transfer method, on certification of the Order Manager/Engineer-in-Charge and on compliance of contractual terms & conditions.

9. **Taxes and Duties:**

9.1 The Contract Price shall be inclusive of all taxes, duties, including but not limited to Customs duty, GST or any local taxes, levies imposed by State/Central/Local governments.

9.2 Taxes as mentioned in the Contract Price or Price Schedule shall be paid to the contractor subject to the Contractor complying with all the statutory requirements and furnishing the relevant documents including error free invoices containing detailed break up of the taxes.

9.3 The tax invoices should contain the details to comply with the GST Law. The supplier shall:

i) Furnish (electronically) and communicate to the Owner, the details of Goods or Services supplied by the 10th of the month succeeding the said tax period,
ii) Upon discovery of any discrepancy, rectify it and shall pay the tax and interest thereof,
iii) Furnish the returns (electronically), for the inward and outward supplies of Goods and/or Services, before the specified dates as per the GST Law,
iv) Communicate the tax paid, credits etc. as and when credited.
v) The Invoice should clearly state the description of the goods, quantity, sale price, tax %, and tax amount;
vi) The Invoice should be signed by an Authorized Signatory.

Bills/Invoices in the name of The Tata Power Company Ltd. with packing lists in triplicate shall be forwarded along with the equipment.

Contractor to furnish GST Registration no. in all invoices as well as Purchaser's (Tata Power's) GST no.

9.4 However the payment of tax shall be restricted to the total amount as indicated in the price schedule.

9.5 Any statutory variation in duties, levies or taxes if applicable and specified in this Contract till the scheduled date for completion of Work and limited to direct invoices of the Contractor shall be to the account of Owner. The Contractor shall have the obligation to provide the necessary documentary evidence / supporting by way of gazetted notifications etc. to prove the change in such levies or taxes between the due date of submission of the Bid and the scheduled date of completion of work to claim the difference.

9.6 The Contractor shall pass on to the Owner all the benefits of either reduction in tax rates, exemptions, concessions, rebate, set off, credits etc. or introduction of new tax rates exemptions, concessions, rebate, set off, credits etc. pertaining to all taxes, duties, imposts, fees and levies in respect of the supplies of Goods or performance of obligations under the contract. This would specifically include reduction of tax rates as a result of statutory changes or judicial rulings.

9.7 Any other taxes, levies and duties not mentioned in Contract Price or Price Schedule but applicable as per any statute (s) or introduction (omission) of new taxes, levies and duties shall be deemed to be included in the Contract Price and shall be to the account of the Contractor.

9.8 For facilitating availment of a credit, set-off, rebate, drawback or like benefit available to the Owner, the Contractor will facilitate the Owner by providing the necessary documentary and/or procedural support. In any process of assessment or re-assessment, of taxes payable by the Owner,

9.9 The Contractor shall bear and pay all the costs, liabilities, levies, interest, penalties in respect of non-compliances of any legal requirements as per various statutory provisions. The contractor shall keep the owner indemnified at all times from any tax liability, interest, penalties or assessments that may be imposed by the statutory authorities for non-compliances or non-observation of any statutory requirements by the Contractor.

9.10 All formalities required under statutes, for availing any concessions under relevant tax laws shall be adhered to by the Contractor.

9.11 Deduction at source: Recovery at source towards income tax calculated at the rate prescribed from time to time under the Income Tax Act 1961 and other relevant sections of Income Tax Act shall be made from the bills of the Contractor and the amount so recovered shall be

deposited with the Income Tax Department. Necessary TDS certificate to this effect will be issued to the Contractor in the prescribed pro-forma.

9.12 If any other taxes / duties / cess etc are to be recovered at source as per government regulations / Legislation from time to time, the same shall be recovered from the bills payable to the Contractor. Necessary receipt to this effect will be issued to the Contractor in this regard as per the applicable legislation.

10. Contract Performance Guarantees (If applicable)

The Contractor shall within 15 days of issuance of this Order/Contract furnish an unconditional irrevocable bank guarantee duly stamped, strictly as per the prescribed format of Owner from any nationalized bank or any scheduled bank having a branch in Mumbai and approved by the Owner for a sum equivalent to 10% of the Total Contract Price valid for the Contract Period and with a claim period of not less than 6 months from the completion of Contract Period. The issuing bank should be advised to send a direct confirmation of issue of bank guarantee to Owner.

In case the Contractor fails to furnish the requisite Bank Guarantee as stipulated above, then the Owner shall have the option to cancel the Contract besides other contractual remedies.

11. Price Reduction:

11.1 In case the Contractor fails to deliver the service/ Complete the work as per the agreed Completion Schedule including intermediate milestones (if applicable), the Owner shall recover from Contractor, as ascertained and agreed Liquidated Damages, and not by way of penalty, a sum equivalent to 1% of the Contract Value per week of delay. The Liquidated Damages referred above may be recovered by the Owner as set off against any amounts payable by the Owner to the Contractor or in any other manner in accordance with applicable laws.

11.2 The overall cap on liquidated damages shall be limited to 10% of the Contract Price.

12. Insurance

12.1 The Contractor agrees to indemnify and protect Owner against all liability, claims or demands for injuries or damages to any person or property growing out of the performance of this order/ Contract.

12.2 The Contractor further agrees to furnish evidence of insurance showing that Contractor has and will maintain adequate insurance coverage during the life of this Contract/ order in the opinion of Owner, including but not limited to comprehensive general liability insurance. Such evidence of insurance must set forth the name of the insurer, policy number, expiration date, and limits of liability. Compliance by Contractor with insurance requirements does not in any way affect Contractor's indemnification of Owner under Indemnification clause

13. Indemnification:

The Contractor shall indemnify, save harmless and defend the Owner and keep the Owner indemnified from and against any and all claims, costs, liabilities (financial), litigations, compensations, judgments, expenses or damages (including attorney's fees and other related expenses) arising out of any breach or alleged breach of any of the conditions of this Contract including compliance to statutory laws of provisioned under clause 3, performance of the obligations hereunder, or any representation or misrepresentation made by the Contractor or by any third party in respect of death or bodily injury or in respect to loss or damage to any property with regard to the subject of this Contract.

14. Indemnity against IPR:

The equipment, system, drawings, and other materials that shall be supplied against the Contract will become the Owner's property. Without limitation of any liability of whatsoever nature, the Owner shall be indemnified and kept indemnified against any claim for infringement or breach of any of the statues, rules & regulations by the use of or sale of any article or material supplied by the Contractor. The indemnity shall include any infringement of patent, trade mark, design, copyright or other property rights whether in Country of Origin, or elsewhere resulting from the Contractor's design, manufacture, use, supply or re-supply & would also cover use or sale of any article or material supplied by the Contractor to the Owner under the Contract. The Indemnity shall cover any claim/action taken by a third party either directly against the Owner or any claim/action made against the Contractor & where under the Purchaser is made liable. The Indemnity shall be for losses, damages, and costs including litigation costs, attorney fees etc incurred by the Owner in relation to the Contract.

15. Free Issue Material:

Wherever contracts envisage supply of Free Issue Material (FIM) by the Owner to the contractor for fabrication/ use in service performance, such Free Issue Material shall be safeguarded by an insurance policy to be provided by the Contractor at his own cost for the full value of such materials and the insurance policy shall cover the following risks specifically and shall be valid for six months beyond the Contract Validity date :

RISKS TO BE COVERED: Any loss or damage to the Owner's materials due to fire, theft, riot, burglary,

strike, civil commotion, terrorist act, natural calamities etc. and any loss or damage arising out of any other causes such as other materials falling on Owner' s materials.
The amount for which insurance policy is to be furnished shall be indicated in the respective Contract.

Free Issue material (FIM) will be issued to the Contractor only after receipt of the Insurance Policy from the Contractor. The contractor shall arrange collection of the FIM from the Owner's premises and safe transportation of the same to his premises at his risk and cost. Notwithstanding the insurance cover taken out by the Contractor as above, the Contractor shall indemnify the Owner and keep the Owner indemnified to the extent of the value of free issue materials to be issued till such time the entire contract is executed and proper account for the free issue materials is rendered and the left over/surplus and scrap items are returned to the Owner. The contractor shall not utilize the Owner's free issue materials for any job other than the one contracted out in this case and also not indulge in any act, commission or negligence which will cause/result in any loss/damage to the Owner and in which case, the Contractor shall be liable to the Owner to pay compensation to the full extent of damage/loss. The Contractor, shall be responsible for the safety of the free issue materials after these are received by them and all through the period during which the materials remain in their possession/control/custody. The Free issue materials on receipt at the Contractor's works shall be inspected by them for ensuring safe and correct receipt of the material. The contractor shall report the discrepancies, if any, to the Owner within 5 days from the date of receipt of the material. The contractor shall take all necessary precautions against any loss, deterioration, damage or destruction of the FIMs from whatever cause arising while the said materials remain in their possession/custody or control. The free issue materials shall be inspected periodically at regular intervals by the Contractor for ensuring safe preservation and storage, the Contractor, shall also not mix up the materials in question with any other goods and shall render true and proper account of the materials actually used and return balance remaining unused material on hand and scrap along with the final product and if it is not possible within a period of one month from the date of delivery of the final product/ completion of Service covered by this Contract. The Contractor shall also indemnify the Owner to compensate the difference in cost between the actual cost of the free issue material lost/damaged and the claim settled to the Owner by the insurance company.

16. Relation between parties:

The Contract shall be entered into on a principal-to-principal basis only. The Contract shall not be construed as a partnership or an association of persons. There is no agent and principal relationship between the parties. Each party shall be responsible for its own conduct. The Contractor shall ensure at all times that all the work carried out under this contract either by its own person or through any of its sub-Vendors shall be always done under its own direct supervision.

17. Safety:

Contractor shall comply with all legal and statutory provisions including all rules and regulations pertaining to Safety, Health and the Environment and will be responsible for all legal liabilities arising due to any of their acts or of their personnel.

The Contractor shall comply with the Owner's Contractor Safety Policy and Safety Terms and Conditions. Any misconduct and/ or violation with respect to the Owner's Contractor Safety Policy and Safety Terms and Conditions or any other legal and statutory provisions pertaining to Safety, Health and Environment shall be dealt with as per the Safety Terms and Conditions.

Prior to commencement of any work at site Contractor shall submit an undertaking in writing to adhere to and comply with all the provisions of Owner's Contractor Safety Code of Conduct.

The Contractor shall have a valid ISO 14001/ OHSAS certification. In absence of the same, the Contractor shall obtain the same within 6 months from the date of the Effective Date of Contract.

18. Suspension of Work

Owner may instruct Contractor at any time to suspend performance of the Work or any part thereof with a notice of 7 days for whatever reason. Provided Contractor is not in default under this Contract subject to Articles 1 and 5 inclusive, the Contractor shall be paid a mutually agreed fee, if any, necessarily incurred by Contractor as a direct consequence thereof of suspension and the Project Completion Schedule may be revised accordingly.

Without prejudice to any other rights Owner may have under this Contract or at law if Contractor is in default under this Contract, Owner may instruct Contractor to suspend performance of the Work or any part thereof by giving 7 days notice till such default has been corrected to the satisfaction of Owner. Also Liquidated Damages in accordance with Clause 11 shall continue to be applicable during such period until the default is cured. The costs incurred by the Contractor for such correction shall be to the Contractor's account, and furthermore no payment shall become due to the Contractor. Any cost incurred due to non - performance of the Contractor by the Owner shall be charged to the Contractor.

19. Change Management:

Owner shall have the right at any time to order any change in the Work in accordance with the following procedure. Contractor shall furnish to Owner upon request as soon as reasonably possible but no later

than five (5) days following the request, a written statement specifying:

(a) the increase or decrease, as the case may be, in the costs of the Work which will result from a change in the Work as requested by Owner,

(b) any effect such change in the Work may have on any other provision of this Contract originating from either parties, and

(c) such other details as Owner may require.

Any change in costs shall be reasonably related to the proportional change in the Work and any other costs incurred by Contractor. If Owner agrees to Contractor's statement Owner shall notify Contractor thereof in writing in the form of a change order, whereupon the change in the Work shall be incorporated in the Work and immediately implemented. In the event that the change relates to a reduction in Work, the work in question shall not be undertaken pending the issue of an appropriate Change Order.

20. Governing Laws

This Contract shall be construed in accordance with and governed by the Laws of India without giving effect to any principle of conflict of law.

21. Jurisdiction

This Contract and the transaction contemplated herein shall be subject to the exclusive jurisdiction of the competent Courts in Mumbai only.

22. Dispute settlement:

Dispute or differences arising out or relating to this Order shall be resolved amicably by the parties. Failing such amicable resolution of dispute / differences either party may refer the matter to arbitration of a Sole Arbitrator to be appointed jointly by both the parties. The award of the Arbitrator shall be final, binding and conclusive on the parties. The venue for arbitration shall be Mumbai. The Arbitration proceedings will be governed and regulated by the provisions of Indian Arbitration and Conciliation Act, 1996 as amended from time to time and the rules framed there under.

23. Force majeure:

23.1 In the event of either party being rendered unable by force majeure to perform any obligation required to be performed by it under this Contract the relative obligation of the party affected by such force majeure shall, after notice under this articles be suspended for the period during which such cause lasts. The term 'Force Majeure' as employed herein shall mean acts of God, wars (declared or undeclared), riots or civil commotion, fire, floods, and acts and regulations of the Government of India or State Government or any of the statutory agencies. Both the party shall pay to the other party, the amount payable upon the date of the occurrence of such force majeure.

23.2 Upon the occurrence of such cause and upon its termination, the party alleging that it has been rendered unable as aforesaid, thereby shall notify the other party in writing immediately but not later than twenty four (24) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of the claims.

23.3 During the period, the obligations of the parties are suspended by force majeure; the contractor shall not be entitled to payment of any rate.

23.4 In the event of the force majeure conditions continuing or reasonably expected to continue for a period more than thirty (30) days, Owner shall have the option of terminating the contract by giving seven (7) days notice thereof to the contractor.

24. Sub letting and Assignment

The contractor shall not, without prior consent in writing of the Owner, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever, provided nevertheless that any such consent shall not relieve the contractor from any obligation, duty or responsibility under the contract.

25. Limitation of Liability:

Notwithstanding anything contained in the Contract, the Contractor's aggregate liability under this Contract shall be limited 100% of the Total Contract value. This shall exclude liability arising pursuant to clause 3-Compliance to Local Laws, clause 9.10, clause 14-Indemnity against IPR, clause 13- Indemnity, clause 26 – Confidentiality, liability arising due to loss of or damage to the Free Issue Material (FIM) issued by Owner to Contractor for completion of the Work and liability arising due to wilful misconduct, gross negligence, third party claims and corrupt acts attributable to the Contractor.

26. Confidentiality:

The Contractor shall use the Confidential Information of the Owner only in furtherance of this Contract and shall not transfer or otherwise disclose the Confidential Information to any third party. The Contractor shall (i) give access to such Confidential Information solely to those employees with a need to have access thereto; and (ii) take the same security precautions to protect against disclosure or unauthorized use of such Confidential Information that the party takes with its own confidential information but, in no event, shall a party apply less than a reasonable standard of care to prevent such disclosure or unauthorized use.

27. Termination:

27.1 The Contract shall be deemed to be terminated on completion of the Contract period.

27.2 Termination of default by Contractor:
Owner may terminate the contract at any time if the Contractor fails to carry out any of his obligations under this Contract. Prior to termination, the Contractor shall be advised in writing of the causes of unsatisfactory performance to be improved upon 15 days of the receipt of notice. In case, if the Contractor fails to bring about the improvement to the satisfaction of the Owner, then the Contract shall be terminated.

27.3 Without prejudice to the rights and remedies available to Owner, Owner may terminate the Contract or part thereof with immediate effect with written notice to the Contractor if,:

27.3.1 The Contractor becomes bankrupt or goes into liquidation.

27.3.2 The Contractor makes a general assignment for the benefit of creditors.

27.3.3 A receiver is appointed for any substantial property owned by the Contractor.

27.3.4 The Contractor is in breach of any representation or warranty made to the Owner by the Contractor.

The Contractor shall not be entitled to any further payment under the Contract if the Contract is terminated. If the order is terminated under clause 27.2 and 27.3, the Contractor shall not be entitled to any further payment, except that, if Owner completes the Work and the costs of completion are less than the Contract Price, the Owner shall pay Contractor an amount properly allocable to services fully performed by Contractor prior to termination for which payment was not made to Contractor. In case, the cost of completion of Work exceeds the Contract Price, the additional cost incurred by Owner for such completion shall be paid by the Contractor.

27.4 Owner shall be entitled to terminate the Contract at it's convenience, at any time by giving thirty (30) Days prior notice to the Contractor. Such notice of termination shall specify that termination is for Companies convenience and the date upon which such termination becomes effective. Upon receipt of such notice, the Contractor shall proceed as follows:

27.4.1 cease all further work, except for such work as may be necessary and instructed by the Owner/ Owner's representative for the purpose of preserving and protecting Work already in progress and protect materials, facilities and equipment on the Work Site or in transit;

27.4.2 stop all further sub-contracting or purchasing activity, and terminate Sub-contracts;

27.4.3 handover all Documents, equipment, materials and spares relating to the portion of Work already executed by the Contractor or procured from other sources up to the date of termination for which the Contractor has received payment equivalent to the value thereof; and

27.4.4 handover those parts of the supplies manufactured/ work executed by the Contractor up to the date of termination.

Upon termination pursuant to clause 27.4, the Contractor shall be entitled to be paid (a) all sums properly due to the Contractor under the Contract up to the date of termination; and (b) any direct and substantiated charges already incurred or committed for cancellation of the procurement of third party goods or services which were to have been supplied by the Contractor in connection with this Contract provided that the Contractor shall use its best endeavours to minimise such charges

25.5 The Contractor shall not be released from any of his obligations or liabilities accrued under the Contract on termination. For the avoidance of doubt, the termination of the Contract in accordance with this clause shall neither relieve the Contractor of his accrued obligations for Warranty or his accrued liability to pay (liquidated) damages for Delay nor shall entitle him to reduce the value of Performance Security.

28. Consequential Damages:

Unless otherwise specified, neither Party shall be responsible for and nor shall be liable to the other Party for indirect/consequential losses and damages suffered by such Party including for loss of use, loss of profit whether such liability or claims are based upon any negligence on the part of the other Party or its employees in connection with the performance of the Contract.

29. Environment / ISO 14001 Certification:

The Contractor to confirm whether their organization is ISO 14001 certified. If not, the Contractor must certify that the handling, use and disposal of their product / by-products conform to practices consistent with sound environmental management and local statutes. The Contractor shall ensure that all the wastes are disposed in environmental friendly way with strict compliance to applicable laws including adherence to MoEF guidelines with respect to disposal of batteries, lead waste, copper cables, ash, waste oil, e-waste etc which shall be disposed through MoEF approved

parties only. The Contractor shall also be responsible to collect and recycle all the e-waste generated at the end of the product life cycle at its own costs and risks as per the MoEF guidelines/ orders.

30. Non-Exclusive Agreement

This Contract is non-exclusive and Owner reserves the right to engage other contractors to perform similar or identical work. Contractor shall accord such other contractors adequate opportunity to carry out their contracts and shall accomplish the Work in co-operation with those contractors and with Owner, in accordance with such instructions as may be issued by the Owner from time to time.

31. Severability

In the event that any of the provisions, or portions or applications thereof, of this Contract are held to be unenforceable or invalid by any court or arbitration panel of competent jurisdiction, Contractor and Owner shall negotiate an equitable adjustment to the provisions of the Contract with a view towards effecting the purpose of the Contract and the validity and enforceability of the remaining provisions, or portions or applications thereof, shall not be affected thereby.

32. Housekeeping & Removal of scrap:

The Contractor shall be responsible for keeping the areas of his work at site, neat and tidy throughout the period of his work. All excess material/ spares/ consumables taken by Contractor, as well as the scrapped items and wooden logs/ crates/ planks shall be returned, from time to time, to the Stores, and transported/ unloaded by Contractor's personnel at the place shown by Order Manager/Engineer-in charge.

The Contractor shall so arrange that all the scrap generated during the progress of his work, is separated into two categories, viz.

i) Saleable scrap like steel, copper or other metals, etc., and,

ii) Others, which have nil or negligible resale value, like insulation material, jute, debris, etc. (or as directed by the Order Manager/Engineer-in charge).

The saleable scrap shall be shifted to and unloaded at a central place as per directions of the Stores-in charge, while the other scraps shall be shifted to other locations as per directions from Order Manager/ Engineer-in Charge, or as per terms of the order.

The Contractor shall arrange to remove the scrap on regular basis, or even on daily basis, depending upon the requirement, to keep the area around his work-place neat and tidy. In case, it is observed that the Contractor is not carrying out regular cleaning of his areas of work, or, is not returning the excess materials/ scrap, etc., to the Stores, Owner reserves the right to arrange the same through other sources, and back-charge the Contractor the cost of doing so, along-with overheads, by deducting the amount from Contractor's bills.

Contractor's final bill will be cleared by Owner only after confirming that proper clearing of his areas of work has been completed by the Contractor, and same is certified by the Order Manager/ Engineer in-charge

33. Tata Code of Conduct

The Owner abides by the Tata Code of Conduct in all its dealing with stake holders and the same shall be binding on the Owner and the Contractor for dealings under this Order/ Contract. A copy of the Tata Code of Conduct is available at our website: http://www.tatapower.com/aboutus/code-of-conduct.aspx. The Contractor is requested to bring any concerns regarding this to the notice of our Chief Ethics Officer on the e-mail ID: cecounsellor@tatapower.com.

34. Responsible Supply Chain Management:

The Owner is committed for a cleaner environment and respect of Human rights through its Responsible Supply Chain Management policy. The Contractor is required to comply with all the environment & Human rights related laws, including emission norms, Labour and environmental regulations. The Owner encourages its Vendors/ Contractors/ Business partners to pay more attention to green design, green supply, green production, green logistics and green packaging in performing their business obligations.

The Contractor is required to abide by the Tata Power Corporate Environment policy, Energy Conservation and Corporate Sustainability Policy.

A copy of the Responsible Supply Chain Policy along with Environment policy, Energy Conservation policy, Sustainability policy, Health & Safety policy and Human Rights policy is available at website: http://www.tatapower.com/sustainability/policies.aspx.

Contractor/Bidder is required to completely fill the attached "Supplier Sustainability Questionnaire" in support of their Green Supply Chain Management initiatives and submit the same with their offer.

The Owner recognizes that diversity in the workplace positively impacts business. The Owner is committed to help people from SC/ST background either by helping them to become entrepreneurs or by engaging workforce from SC/ST community under the contracts agreed herein. To encourage engaging SC/ST community, the owner may consider on the merit to incentivize the Contractor by paying additional 1% of

the service contract portion if the number of SC/ST workforce engaged in the contract exceeds 30% of the total deployed strength and 2%, if the strength goes beyond 50%. While the Contractor will assist the workforce so engaged to become self-reliant in meeting the work expectation, the Owner may also volunteer its training resources to the extent possible to improve their employability. The Contractor shall maintain the proper documentation of such category of the workforce engaged and the owner may consider to pay the incentive after its verification.

The Owner may also consider extending price preference of 5% in the bid evaluation for an order value up to Rs.50 Lacs, provided the company is owned by a person from SC/ST community having minimum 50% holding in the company.

35. Vendor rating:

You are requested to ensure compliance to the terms of the individual orders with regards to timely delivery, provision of all applicable documents / challans / test certificate, quality of the material etc. Your performance with respect to the said factors will be taken into consideration for future business.

36. Vendor Feedback:

34.1 In this dealing Vendors feedback is important for the purchaser to improve its processes. If Contractor have to report any grievance, problem or require any clarification, information, Contractor is requested to contact purchaser at email ID: CC_CUSTOMERFEEDBACK@tatapower.com

34.2 Contractor is requested to ensure compliance to the terms of the individual orders with regards to timely delivery, provision of all applicable documents / challans / test certificate, quality of the material etc. Contractor performance with respect to the said factors will be taken into consideration for future business.

37. Non-Waiver:

Failure of Owner or its representatives to insist upon adherence to any of the terms or conditions incorporated in the Contract or failure or delay to exercise any right or remedies herein or by law accruing, or failure to promptly notify the Contractor in the event of breach or the acceptance of or the payment of any Material(s) hereunder or approval of any design or Material(s) shall not release the Contractor and shall not be deemed a waiver of any right of Owner to insist upon the strict performance thereof or of any of its rights or remedies as to any such Material(s) regardless of when the Material(s) are shipped, received or accepted not shall any purported oral modification or revisions of the Contract by Owner or its representative(s) act as waiver of the terms hereof.

Special Terms and Conditions

Item No D.2

1. The information contained in this Tender Document or subsequently provided to Bidder, whether verbally or in documentary or any other form by or on behalf of The Tata Power Company Limited herein referred to as Tata Power, or any of its employees, is provided to Bidder on the terms and conditions set out in this Tender Document and such other terms and conditions subject to which such information is provided.

2. Tata Power also does not accept any liability of any nature whether resulting from negligence or otherwise however caused arising from reliance of any Bidder upon the statements contained in this Tender Document.

3. Tata Power, and its employees make no representation or warranty and shall have no liability to any person including any Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this Tender Document or otherwise, including the accuracy, adequacy, correctness, reliability or completeness of the Tender Enquiry and any assessment, assumption, statement or information contained therein or deemed to form part of this Tender Document or arising in any way in this Selection Process.

4. Tata Power may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumption contained in this Tender Document.

5. Though adequate care taken while issuing this Tender Document, Bidder should satisfy himself for completeness of the document in all respects. Intimation of any discrepancy should be given to Tata Power Concerned Person immediately. If no intimation received by this office within 3 days from the date of issue of the Tender Document, then Tata Power shall consider that the document received by the Bidder is complete and to the satisfaction of the Bidder in all respects.

6. Tata Power reserves the right to change any or all of the provisions of this Tender Document before date of submission. Such changes, if any, would be intimated to Authorized Person of Interested Bidder through E-Tender System only.

7. The issue of this Tender Document does not imply that Tata Power is bound to select a Bidder or to appoint the Selected Bidder, as the case may be, for the Contract and Tata Power reserves the right to reject all or any of the Proposals without assigning any reasons and or making any correspondence on this account whatsoever.

8. Bidder shall bear all costs associated with or relating to the preparation and submission of its Proposal including but not limited to preparation, copying, postage, delivery fees, expenses

associated with any demonstrations or presentations which may be required by Tata Power or any other costs incurred in connection with or relating to its Proposal. All such costs and expenses will remain with the Bidder and Tata Power shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by an Bidder in preparation or submission of the Proposal, regardless of the conduct or outcome of the Selection Process.

Any Bidder wishing to undertake site visits for familiarization with site conditions, may do so. All costs towards site visits, conference and submission of documents shall be borne by the Bidder themselves.

9. No claim shall be entertained on account of disruption of internet services being used by bidders. Bidders are advised to upload their bids well in advance to avoid last minute technical snag.

10. The decision of Tata Power Management regarding the opening of offers, evaluation and acceptance of the offer shall be final and binding on all the Bidders.

11. Tata Power reserves the right to extend the date of uploads/opening of tenders without assigning any reason thereof, and also reserves the right to distribute the work among more than one bidder.

12. Tata Power reserves the right to accept or reject any offer, and to annul the offer process and reject all offers at any time prior to award of Offer, without thereby incurring any liability to the affected Bidder or any obligation to inform the affected Bidder of the grounds for the Tata Power decision.

13. Tata Power reserves the right to invite open or limited tenders and when tenderers are called to accept a tender in whole or in part or reject any tender or all tenders without assigning any reasons for such action.

14. The authority for the acceptance of the tender will rest with the Tata Power. It shall be obligatory on the said authority to accept the most suitable bid or any other bid and no Bidder shall demand neither any explanation for the cause of rejection of his / their tender nor Tata Power undertake to assign reasons for declining to consider or reject any particular tender or tenders.

15. Local Conditions: It will be imperative on each Bidder to fully acquaint himself with all the local conditions and *factors* which would have any effect on the performance of the contract. Tata Power shall not entertain any request for clarifications from the tenderer regarding such local conditions. No request for the change of price, of time schedule of completion of work on account of any local conditions or factor shall be entertained after the offer is accepted by Tata Power.

16. The intending bidder will be deemed to have satisfied himself by actual inspection of the site and locality of the works, that all conditions liable to be encountered during the execution of the works are taken into account and that rates he enters in the tender papers are adequate and all inclusive, for the completion of works to the entire satisfaction of Tata Power.

17. Bidder who is Black listed / Banned / Debarred as on originally scheduled date of this bid opening or whose Agreement / Work order has been terminated on account of performance, or a bidder against whom there is adverse report about its performance under an existing contract or a bidders performance security has been forfeited by any company/organization for non-performance at any time shall not be eligible, within 5 (five) years of originally scheduled date of this bid opening by any State / Central Govt. / Govt. Undertaking / Public sector Undertaking in India for similar type of work, will not be eligible for participating in this tender. The Bidder should submit an affidavit on Letter Head (Format F1) as a proof in this regard.

18. The bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder may result in rejection of Bid.

19. Conditional and incomplete tenders shall not be accepted. Bid must be in conformity with schedules / formats of this tender.

20. At any stage if it is found that bidder

    a. have submitted false document for the purpose of qualifying in the tender or non-execution of project as per contract,
    b. Have not provided relevant details (for example litigation history etc)

    action as per Law will be taken and the pending payment, Bank Guarantee, EMD, Security amount of the bidder will be forfeited by Tata Power at any stage of execution. Also Bidder will be Blacklisted for future Tenders by Tata Power.

21. Issuance of Tender document does not construe that Bidder will be qualified for award of work.

22. Tata Power reserves the right to verify all statements, information and documents, Submitted by the Bidder in response to Tender Document. Any such verification or the lack of such verification by Tata Power to undertake such verification shall not relieve the Bidder of its obligations or liabilities hereunder nor will it affect any rights of Tata Power there under.

--- XXX ---

FORMAT OF EMD – Bid Guarantee BG

Note: a) Format shall be followed in toto
b) Claim period of six months must be kept. In case of Bank is not ready to give BG for six months and claim period of six months EMD BG valid of one year to be given
c) The guarantee to be accompanied by the covering letter from the bank confirming the signatories to the guarantee on the Bank's letter head.

The Tata Power Co Ltd
34,Sant Tukaram Road
Carnac Bunder,
Mumbai 400 009

Whereas (Name of the Contractor), a Company incorporated under the Indian Companies Act 1956, having its Registered office at _____, (hereinafter called the "BIDDER") has in response to your Invitation to Bid against Enquiry No. _____dated _____, for (name of work), offered to supply and/or execute the works as contained in Employers letter dated _____.

AND WHEREAS BIDDER is required to furnish to you a Bank Guarantee for the sum of Rs._____/-(Rupees ____ only) as Earnest Money against Bidder's offer as aforesaid.

AND WHEREAS we, (name of the bank) having our Registered Office at _____and Branch office at _____, have at the request of Bidder, agreed to give you this Guarantee as hereinafter contained.

NOW THEREFORE, in lieu of earnest money deposit, we, the undersigned, hereby covenant that the aforesaid Bid of the BIDDER shall remain open for acceptance by you during the period of validity as mentioned in the Bid Document or any extension thereof as requested by you and if Bidder shall for any reason back out, whether expressly or impliedly, from this said Bid during the period of its validity or any extension thereof as aforesaid, we hereby guarantee to you the payment of the sum of Rs._____/-(Rupees ____ only) on demand and without demur and notwithstanding the existence of any dispute between you and the BIDDER in this regard and we hereby further agree as follows:

(a) You shall have the right to file/make a claim on us under the Guarantee for a further period of six months from the said date of expiry.

(b) That this guarantee shall not be revoked during its currency without your written express consent.

(c) That you may without affecting this guarantee grant time or other indulgence to or negotiate further with BIDDER in regard to the conditions contained in the said Bid document and thereby modify these conditions or add thereto any further conditions as may be mutually agreed upon between you and BIDDER.

(d) That the guarantee hereinbefore contained shall not be affected by any change in the constitution of our Bank or in the constitution of BIDDER.

(e) That any account settled between you and BIDDER shall be conclusive evidence against us of the amount due hereunder and shall not be questioned by us.

(f) That this guarantee commences from the date hereof and shall remain in force till BIDDER, if his Bid is accepted by you, furnishes the Contract Performance Guarantee as required under the said specifications and executes formal Contract Agreement as therein provided or till ____Days (__days) from the date of submission of the Bid by the BIDDER i.e. (expiry date), whichever is earlier.

(g) That the expression, BIDDER and Bank, and OWNER herein used shall, unless such an interpretation is repugnant to the subject or context, include their respective successors and assignees.

(h) Notwithstanding anything herein contained, our liability under this guarantee is limited to Rs._____/-(Rupees _____only) and the Guarantee will remain in force upto and including and shall be extended from time to time for such period or periods as may be desired by you. Unless a demand or claim under this Guarantee is received by us in writing within six months from (expiry date), i.e. on or before (claim period date), we shall be discharged from all liabilities under this guarantee thereafter.

(i) Any claim/extension under the guarantee can be lodgeable at issuing outstation bank or at Mumbai branch and claim will also be payable at Mumbai Branch. **(To be confirmed by Mumbai Branch by a letter to that effect)**

(j) Liability against this Bank Guarantee will be discharged only after issue of Discharge Letter by Tata Power

Notwithstanding anything contained hereinabove :

a) Our liability under this Bank Guarantee shall not exceed Rs._____/-(Rupees _____ only).
b) This Bank Guarantee shall be valid upto ---------- 200.
c) Our Liability to make payment shall arise and we are liable to pay the guaranteed amount or any part there of under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before ---------- 200.

(k) For any correspondence in relation to extension / invocation / discharge of bank guarantee contact us at Tel No._____and Bank branch email id _____

Dated at ..... , this ..... day of .....2020 .

Bank Contact Details:
BG Issuing Person Name:
Contact Number:
e-mail Id.

FORMAT OF PERFORMANCE BANK GUARANTEE

Note: a) Format shall be followed in toto
b) Claim period of six months must be kept up
c) The guarantee to be accompanied by the covering letter from the bank confirming the signatories to the guarantee on the Bank's letter head.

The Tata Power Co Ltd
34,Sant Tukaram Road
Carnac Bunder,
Mumbai 400 009

Our Letter of Guarantee No.....

Contract/Purchase Order No.....dated.....

1.0 You have entered into a Contract No..... with..... .....(hereinafter referred to as " the Vendor") for the supply and delivery of ..... (hereinafter referred t o as "the said equipment") for the price and on the terms and conditions contained in the said contract.

2.0 In accordance with the terms of the said contract, " the Vendor" has agreed to furnish you with an irrevocable and unconditional bank guarantee in a form and from a bank acceptable to you as security for the due performance by " the Vendor" of all his contractual obligations under the said contract in an amount equal to 10% (ten percent) of the total value of the contract to be valid from the date of contract and up to 12 months from the date of satisfactory commissioning of the said equipment into service or 18 months from the date of delivery whichever is earlier.

3.0 In consideration thereof, we, ... hereby irrevocably and unconditionally guarantee to pay to you on demand and without demur and without reference to " the Vendor" such amount or amounts not exceeding the sum of Rs.....(Rupees ..... only) being 10% (ten percent) of the total value of the contract on receipt of your intimating that " the Vendor" has not fulfilled his contractual obligations. You shall be the sole judge for such non-fulfilment and " the Vendor" shall have no right to question such judgement.

4.0 You shall have the right to file/make your **claim** on us under the guarantee for a **further period of six months** from the said date of expiry.

5.0 This guarantee shall not be revoked without your express consent and shall not be affected by your granting time or any other indulgence to " the Vendor", which shall include but not be limited to, postponement from time to time of the exercise of any powers vested in you or any right which you may have against " the Vendor" and to exercise the same in any manner at any time and either to enforce or forbear to enforce any covenant contained or implied in the said contract or any other course or remedy or security available to you, and our Bank shall not be released from its obligations under this guarantee by your exercising any of your rights with reference to matters aforesaid or any of them or by reasons of any other act or forbearance or other acts of omission or commission on your part or any other indulgence shown by you or by any other matter or thing whatsoever which under the law would, but for this provision, have the effect of relieving our bank from its obligation under this guarantee.

6.0 We also agree that you shall be entitled at your option to enforce this guarantee against our bank as a principal debtor, in the first instance, notwithstanding any other security or guarantee that you may have in relation to " the Vendor" 's liabilities in respect of the premises.

7.0 This guarantee shall not be affected by any change in the constitution of our Bank or " the Vendor" or for any other reason whatsoever.

8.0 Any claim/extension under the guarantee can be lodged at issuing outstation branch or at Mumbai branch and also become payable at our issuing outstation bank or at the Mumbai branch as per confirmatory letter/letters of the concerned bank branches as attached. **(This Confirmatory letter is to be obtained from Mumbai Branch by the vendor and submitted along with the Performance Bank Guarantee and is applicable for PBG submitted from Banks located outside Mumbai).**

9.0 Notwithstanding anything herein contained, our liability under this guarantee is limited to Rs..... (Rupees .... only) and the guarantee will remain in force up to and including .....(Date) and shall be extended from time to time for such period or periods as may be desired by " the Vendor" .

10.0 Unless a demand or claim under this guarantee is received by us in writing within six months from ..... (expiry date) i.e. on or before .....(claim period end date) we shall be discharged from all liabilities under this guarantee thereafter.

11.0 For any correspondence in relation to extension / invocation / discharge of bank guarantee contact us at Tel No._____and Bank branch email id_____

Dated at ..... , this ..... day of .....2020 .

Contractor's Safety Code of Conduct

Reason for Change	Prepared By	Checked By	Approved by
Revision to accommodate Existing changes in org structure and to simplify the procedure	Rajesh Sharma *(Head-Safety Generation)*	Suresh Khetwani *(Chief - Safety & Environment)* Monish Kumar *(Chief -Corporate Contract)*	V. V. Namjoshi (Chief Generations)

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1. Objective

The Tata Power engages contractor workforce to execute, run and maintain various operating sites and facilities across locations for various business verticals including Generation, Transmission, Distribution and Renewable. The activities range from project execution, operation, maintenance to facilities management.

The management of contractor safety represents a significant challenge for management. Tata Power has a responsibility to ensure that contractors are provided with enough information and support to enable them to conduct their roles safely and without endangering health and safety of their own workforce or that of our staff.

To ensure reduction in reportable injuries and achieve goal of zero accidents, first edition of contractor safety code of conduct was launched successfully in the year 2014. Since last four years after the launch of CSCC, Tata Power could achieve the objective of reduction in reportable injuries and fatalities.

Over the period, as the system was being matured, a need was felt to make second revision of the CSCC process. Objective of second revision is improve existing CSCC system and make it user friendly.

2. Scope:

This procedure applies to all operating and project sites of The Tata Power Company Ltd and Group companies including new businesses like EV charging, Home Automation etc.

3. Definitions

3.1. **Order Manager:** Order Manager is the Tata Power representative, who has the ownership of the given job.

3.2. **Site Safety Management Plan**: It is the safety plan agreed between Contractor and Tata Power. It will contain the entire job specific safety requirement and will be signed by the contractor.

3.3. **Contractor**: An individual or a company that provides services to Tata Power under a signed contract.

3.4. **Emergency:** a serious, unexpected or dangerous situation requiring immediate action, which may result in loss of revenue/property, business discontinuity. In case of Emergency*, services may be procured by selecting the qualified vendor based on the vendor category without the safety bid evaluation. It must be approved by MB level and above.

3.5. **Expert Service jobs:** Jobs which needs expert services of contractor which does not involve direct exposure to the potential risk or work which involves only

supervisory work such as expert for turbine overhaul, expert for boiler overhaul, expert for pump and motor, expert for compressor overhaul.

3.6. **Head of the Division:** Business in charge of the division who is overall custodian of the generating station or transmission division or distribution division.

3.7. **Category A Vendor:** Vendor eligible to carry out Very High & High risk (as per Tata Power Hazard Identification and Risk Analysis Procedure) and /or Long-Term Contract related to operation and maintenance (O&M) of plant. Vendors must fulfil the requirement specified for Category A in Appendix 12-CSMF-5 of this document.

3.8. **Category B Vendor:** Vendors eligible to carry out technical jobs, that are classified under Medium /low risk. Vendors must fulfil the requirement specified for Category B in Appendix 12-CSMF-5 of this document.

3.9. **Category C Vendor:** Vendors eligible for to carry out low or very low risk administrative and office jobs. For this he must fulfil the requirement specified for Category C in Appendix 12-CSMF-5 of this document.

3.10. **Category D Vendor:** All Consultants, Medical Practitioners or vendors taking job from Tata Power and working from their own premises (e.g. motor rewinding at vendor's shop floor, equipment sent for repair to vendor's works etc.) are classified as Category D Vendor

3.11. **High Risk Jobs:** A Job or its activities are considered as Very High or High Risk when Order manager apply the "Tata Power Hazard Identification and Risk Analysis" procedure and found safety risk associated with are under Very High or High category. Indicative lists of jobs are given in appendix 15 of this document**.**

3.12. **Medium Risk Jobs:** Jobs or its activities are considered as medium risk when Order manager apply "Tata Power Hazard Identification and Risk Analysis" procedure and found the same as Medium Risk.

3.13. **Low Risk Jobs:** Any job or its activities are considered as Low or Very low risk while Order manager, calculate it by applying "Tata Power Hazard Identification and Risk Analysis" procedure and found it under Low or Very Low category.

3.14. **Long Duration Jobs:** When the duration of job is 12 months or more, it is considered as Long duration job

3.15. **High Value Jobs:** When the value of the job contract is Rs. One Crore or more it will be considered as High value job**.**

4. Responsibilities

4.1 Order Manager: Order Manager is the Tata Power representative, who is responsible for:

4.1.1 Finalizing the Site Safety Management Plan along with Contractor, Safety Concurrences Group, Divisional Safety Head and Expert (External or Internal) if required.

4.1.2 Supervise and ensure work is carried out as per the Site Safety Management Plan including agreed Risk Assessment (HIRA/JSA) and Method Statement.

4.1.3 Conduct audit and evaluate Safety Performance of contractor.

4.1.4 Ensure contractors adhere to all statutory provisions.

4.1.5 In case any deviation is needed in agreed safety management plan or in CSCC process for execution of job, Management of Change procedure will be applicable, and approval may be obtained from divisional head /Cluster head.

4.2 Contractor: The person, entity or organisation who is executing the job for Tata Power under a contractual agreement and will be responsible for the following

4.2.1 To follow all Tata Power Critical Safety Procedure, Rules and guidelines given in Safety Terms and Conditions

4.2.2 Undertake job as per Site Safety Management Plan CSM-F10 and method statements agreed with Tata Power.

4.2.3 Raise any concerns with regard to their work and its safety with the Tata Power Order Manager.

4.2.4 Report all injuries, near misses, unsafe acts/conditions, and occurrences to the Tata Power Order Manager immediately.

4.2.5 Ensure that all sub-contractors follow the Tata Power Safety Procedure and agreed Site Safety Management Plan CSM-F10.

4.2.6 To follow all statutory requirements as per the laws of the land.

4.2.7 All vendors applying for A category jobs or submitting quote for high risk jobs shall obtain certificates of ISO 9001, ISO14001 and ISO45001 before submitting quote for high risk Jobs.

4.3 Safety Concurrence Group: It is Cross Functional Team constituted by Corporate Safety Team, which will have representatives from Execution department, Divisional safety and Corporate / Divisional contracts. SCG will be responsible for the following

4.3.1 Assessment of Safety Potential of new vendor before registration as per CSM-F1-Safety Category Qualification Form.

4.3.2 Safety Evaluation of the bids as per evaluation format CSM-F-9 Safety Bid Evaluation Criteria

4.3.3 Finalization of the Site Safety Management Plan CSM-F-10 submitted by the contractor.

4.3.4 Corporate Safety Team / Cluster Safety Head will be part of SCG during Safety Bid Evaluation for following types of jobs

4.3.4.1 High-Risk jobs to be carried out in Annual Overhaul / Major Shutdowns and Outages.

4.3.4.2 Capex jobs of High-Risk Category

5.1 Vendor Registration

For Vendor Registration, Corporate Contract will issue following documents for evaluation of contractor's safety capability

1) CSM-F1 –Safety Category Qualification Form
2) Safety Terms and Conditions

The document Safety Terms and Conditions provides the information about Tata Power safety System to the contractor. Contractor will submit the CSM-F1- Safety Category Qualification Form with all relevant details and documents to Vendor Registration Initiator, which will in turn forward it to Safety Concurrence Group (SCG) for evaluation. The SCG will evaluate the details submitted by the contractor based on a predetermined criteria CSM-F-5 Safety Potential Evaluation Criteria for Vendor Registration and will determine the category (Category A/B/C/D) for which the contractor will be registered. As mentioned in the above criteria, a site visit may also be organized by SCG prior to registration under Category A and B. In case, the contractor does not qualify the safety criteria, the contractor will not be registered. However, he may apply afresh for registration after 6 months. Please refer Appendix 1: Process Flow Chart for Vendor Registration.

5.2 Bid evaluation

At the time of placing the Purchase Requisition (PR), Order Manager is required to declare the risk involved in the of the job (i.e. High Risk / Medium Risk / Low Risk jobs, based on the RPN in HIRA. If the Job is "High Risk" or "Long Duration", then RFQ will be attached with following documents:

1) CSM-F7- Blank Safety Competency Form
2) CSM-F8 PPE requirements
3) Safety Terms and Conditions
4) Job Specific Safety Requirement (Educational and Professional Qualification, Skill & Experience Manpower, Tools and Tackles (e.g. man lifter, use of drone, use & availability of rescue kit), Work Methodology etc.)

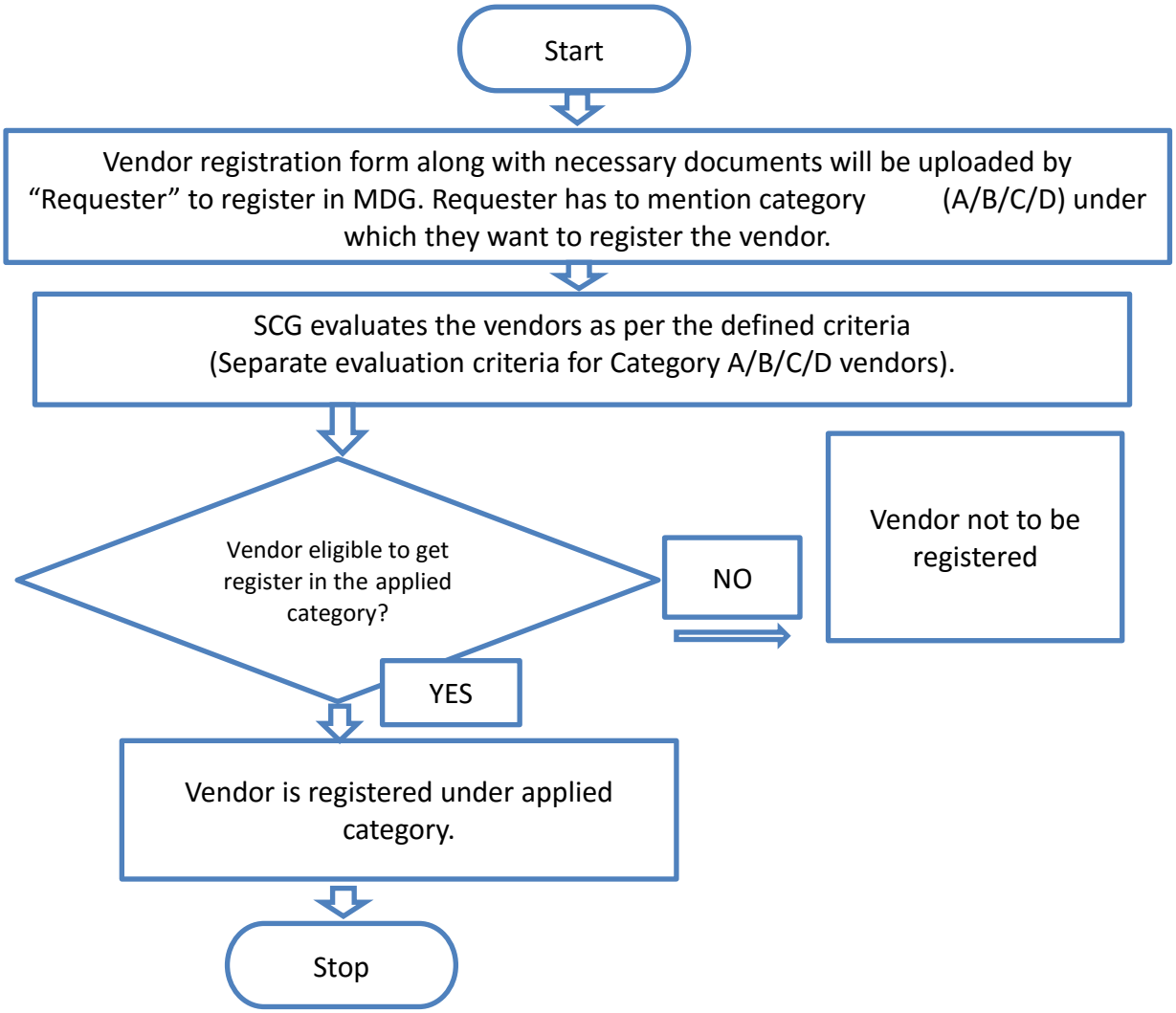
Otherwise the RFQ will be attached only with Safety Terms and Conditions. Long term and low value jobs (see definition) are exempted from the CSCC process.

Corporate Contracts will collect duly filledCSM-F7 Safety Competency Form along with the bid. All other stakeholders will also put their efforts to get all relevant safety data during meeting / discussions with the vendor. SCG will evaluate the document as per the CSM-F9 Safety bid evaluation criteria. If any specific condition related to Contract is required to convey to contractor, Site safety team will attach the same as Annexure for specific conditions of job and submit it to contract team along with safety bid evaluation form. Commercial bid of contractor will be considered for evaluation by contract team only if contractor is qualified in safety bid. Site Safety Management Plan, defining the complete procedure of executing the job at site will be signed by the contractor and SCG after mutual agreement. CC will attach a copy of site safety Management Plan and any specific condition of contract along with PO to the successful bidder. Please refer Appendix 6: Process Flow Chart for issuing RFQ and PO significant health and safety risk associated with it.

5.3 Safety Performance Evaluation

During the time of job execution, regular site inspection will be carried out by the Tata Power officials and violations will be dealt as per CSM–F4 Safety Violation Penalty Criteria. Apart from this, monthly safety performance of the contractor will be evaluated based on the predetermined criteria as per CSM-F11 safety Performance Score and monthly score will be maintained by the Order Manager. Certain percentage of each running bill will be retained as Safety Retention amount and will be released on the basis of Safety Performance Score at certain intervals as defined in CSM- F-3- Safety Performance Evaluation Criteria. Please refer Appendix 10: Process Flow Chart for Safety Performance Evaluation. Percentage of retention amount is mentioned in safety terms and conditions.

Appendix 1: Process Flow Chart for Vendor Registration


Start
Vendor registration form along with necessary documents will be uploaded by "Requester" to register in MDG. Requester has to mention category (A/B/C/D) under which they want to register the vendor.
SCG evaluates the vendors as per the defined criteria (Separate evaluation criteria for Category A/B/C/D vendors).
Vendor eligible to get register in the applied category?
NO
Vendor not to be registered
YES
Vendor is registered under applied category.
Stop

Appendix 2: CSM-F-1 Safety Category Qualification form

1. "**Safety Category Qualification Form**" is part of vendor registration form. It needs to be filled by the contractor at the time of Registration and should submitted to Requester / order manager with all relevant documents.
2. The same will be evaluated by Safety Concurrence Group of the Division (SCG) as per the criteria given in CSM-F-5.
3. Information provided by contractor will be verified during site visit.

Safety Category Qualification Form

Please Consider my application for

Category A Vendor: Vendor eligible to carry out Very High- and High-risk O&M jobs
Category B Vendor: Vendors eligible to carry out technical jobs, classified as Medium / low risk
Category C Vendor: Vendors eligible for to carry out low or very low risk administrative and office jobs
Category D vendor: All Consultants, Medical Practitioners or vendors taking job from Tata Power and working from their own premises.

<table>
<tr><td colspan="4">Name of the Vendor:</td></tr>
<tr><td>Sr. No</td><td>Safety Information</td><td>Remarks</td><td>Attachment</td></tr>
<tr><td>1</td><td>Certified for
i. OHSAS 18001/ ISO 45001,
ii. ISO: 14001
iii. ISO: 9001
(ISO certificates to be issued from reputed accreditation agencies specified by Tata Power)</td><td>i. Y/ N
ii. Y/ N
iii. Y/ N</td><td>Attach copy of the certification</td></tr>
<tr><td>2</td><td>Safety Statistics for Last Three (3) Years
- LTIFR
- LTISR</td><td>Yes/No</td><td><table><tr><td></td><td>Year 1 (Last FY)</td><td>Year 2</td><td>Year 3</td></tr><tr><td>LTIFR</td><td></td><td></td><td></td></tr><tr><td>LTISR</td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>3</td><td>Do you have Safety Policy?</td><td>Yes/No</td><td>Attach copy of the safety policy.</td></tr>
<tr><td>4</td><td>Do you have Safety training process?</td><td>Yes/No</td><td>Attach safety training process.</td></tr>
<tr><td>5</td><td>Do you have Safety organization structure e.g. Safety Officers and Safety Committees?</td><td>Yes/No</td><td>Attach copy of the safety organization structure.</td></tr>
<tr><td>6</td><td>Name and address of sites where work is in progress or worked earlier</td><td>Yes/No</td><td>Site details to be attached for inspection by Officials.</td></tr>
</table>

Signature :
Name and Designation :
Stamp of Organization :

Appendix 3: Safety Terms and Conditions

Please refer the attached document Safety Terms and Conditions.

Appendix 4: CSM- F-3- Safety Performance Evaluation Criteria

1. A certain percentage of the bill value will be retained against every running bill as safety performance retention. The amount will be released with the last invoice or every six-month based on Safety Performance Score of contractors. The retention amount will be calculated based on contract value as below.

Contract Value	Retention Amount (%)
Up to 10 Lakhs	2.5
10 – 50 lakhs	2
0.5 to 10 Cr	1.5
>10 Cr	1

2. The evaluation criteria include Lead Indicators such as CFSA (Contractor Field safety Audit) score, percentage of workers trained in TPSDI, inspection of critical equipment. Lag indicators such as Fatalities, LWDC and man days lost.
3. The retention amount saved will go to a separate Safety Improvement Fund.
4. For the contract value of more than Rs 1 Cr or contract duration more than 12 months, the retention amount shall be released half yearly based on safety performance. For all remaining contracts, the retention amount will be released with the final bill.
5. Long term jobs with low value (Less than Rs. 1 Cr.) are exempted from the safety retention. Invoice of these type of jobs can be cleared without safety retention.
6. In case of job stoppage due to safety violations / unsafe observations at the site, no time extension shall be given to the contractor, if such delays are attributable to contractor.
7. In case of fatality, limb loss or loss of property, vendor must pay for liability, legal, statutory and additional mutually agreed settlement charges imposed by the appointed committee. This charge is over and above the retention amount.
8. The committee will finalize an amount between 5 -50 lakhs based on factors such as advise by statutory authorities, contract value and impact of accident etc.
9. Safety performance bonus 1% (limiting to 50 lakhs) of the invoice value will be considered at the end of the job if the contractual safety performance score 100%.
10. During the progress of the work, concerned Supervisor/Engineer will visit and inspect the work site regularly and evaluate the safety performance of the contractor based on matrix attached herewith and apply the Consequence management policy as applicable.
11. Order Manager, divisional chief and SBU head have the authority to terminate the contract in case of three consecutive serious violations.

Safety Performance Evaluation report- CSM-F-3

	Lead Indicators	**Unit Of measurement**	**Target**	**weight age**
1	% of Employee certified in TPSDI/Authorized agency	%	50%	10
2	CFSA score (Annexure 6.1)	Average Severity of Violations	1.49	20
3	Monthly inspection completed by contractor for Critical Equipment, lifting Tools & Tackles and hand tools used at site as per Tata Power Checklist	%	80	5
4	Revalidation of Condition of tools, tackles and equipment by Order Manger.	%	100	15
	Lag Indicators			
1	Number of Fatalities	No.	0	30
2	Number of Lost workday case (LWDC)	No.	0	10
3	Man-days Lost	No.	0	10

Appendix 5: CSM- F-4 Safety Violation Penalty Criteria

Penalty shall be imposed on the contractors under the following circumstances for breaching the contractual agreements:

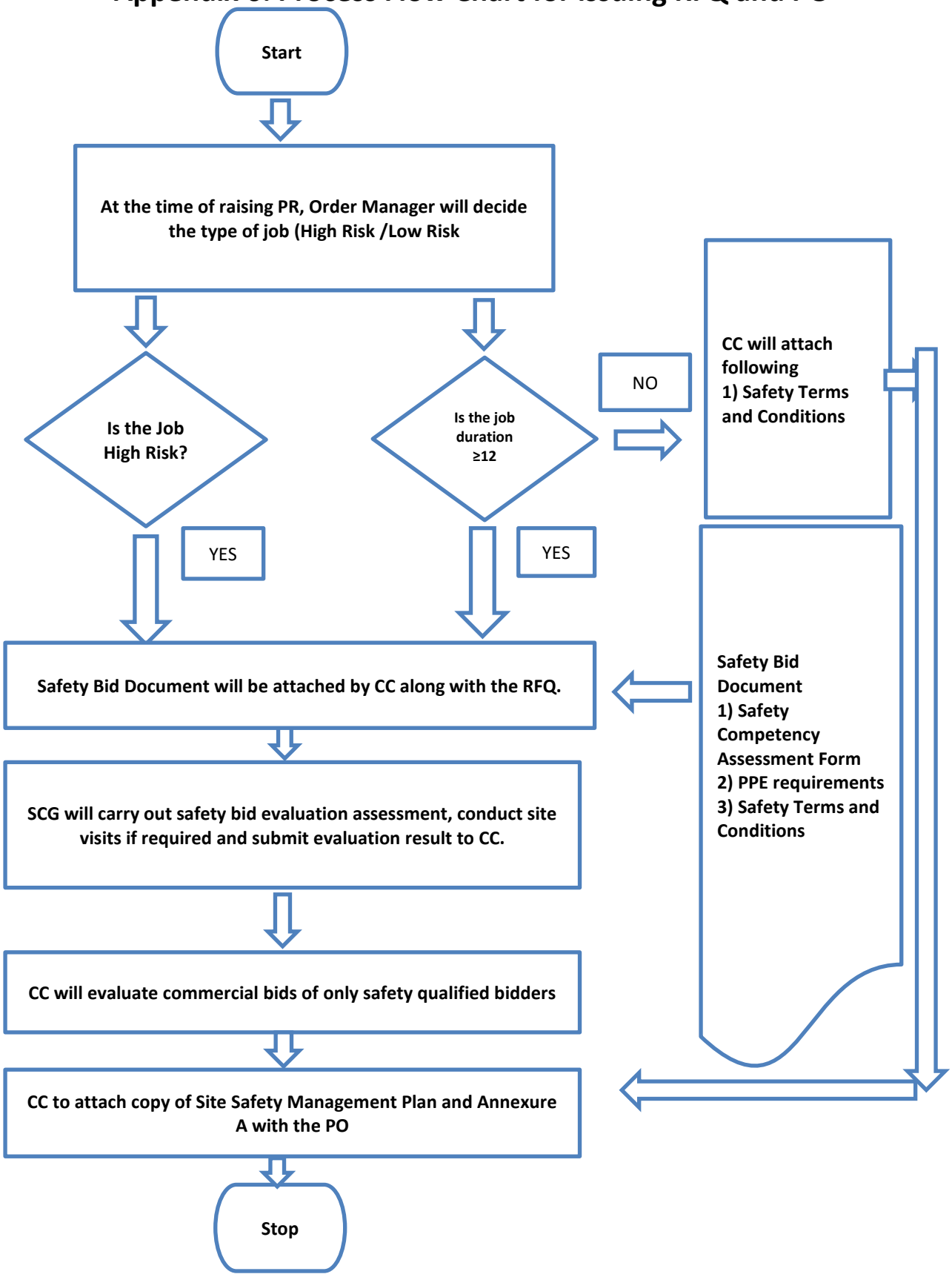
Sr No	Description of violation	Severity	Penalty
1.	Working without Permit	5	5000/-
2.	Untrained (TPSDI) worker on high-risk jobs.	5	5000/-
3.	Unhygienic/Bad condition of PPE	2	250/-
4.	Not following Tata Power Procedure & Standard	4	2000/-
5.	Unsafe Act/Condition of Severity 4	4	2000/-
6.	Unsafe Act/Condition of Severity 5	5	5000/-
7.	No Earthling of Electrical equipment	5	5000/-
8.	Damaged welding cable	5	5000/
9.	Violation of Positive Isolation Procedure (LOTO Not followed)	5	5000/
10.	ELCB of more than 30 mA/ELCB not working	5	5000/
11.	On/Off switch of welding m/c not working	5	5000/
12.	Electric cable tied with metal wire	5	5000/
13.	Leakage found DA hose / cylinder	5	5000/
14.	Use of LPG	5	5000/
15.	Use of IC engine based Three-wheeler at the work site.	5	5000/
16.	Starting the job without Toolbox Talk	5	5000/
17.	Spatter falling on DA hose / Gas-line/ pathways / Equipment	5	5000/
18.	No safety latch in crane hook	5	5000/
19.	Load raised or swung over people or occupied areas of buildings	5	5000/
20.	Persons standing in swing area of construction equipment.	5	5000/
21.	Using damaged slings.	5	5000/
22.	Unstable scaffolding/nonstandard Scaffolding in use	5	5000/
23.	Handrails and mid-rails are missing	5	5000/
24.	Safety Harness not anchored with lifeline/fixed structure	5	5000/
25.	Fall arrestor not provided/ Not being used.	5	5000/
26.	Double lifeline not used for working at height	5	5000/
27.	No rubber mat in- Electrical Distribution (DB) room	4	2000/-
28.	Water found accumulated in Electrical Distribution room/near welding machine.	4	2000/
29.	Inserting electric cables into socket, without using plug.	4	2000/
30.	Use of damaged electrical cable/two core cables.	4	2000/
31.	Inflammable material found in Distribution Room / welding areas.	4	2000/

32.	Loose material falling into excavated pit	4	2000/
33.	Water logging into excavated pit /trenches	4	2000/
34.	No / inadequate Barricade	4	2000/
35.	Undercut / cave-in found on sides of excavated pits	4	2000/
36.	Grinding wheel/ Coupling/ Piling winch/other rotating parts without guard	4	2000/
37.	The HMV/Mobile Crane operator does not have a valid HMV driving license.	4	2000/
38.	The loading area is not leveled properly.	4	2000/
39.	Ladder not anchored at top	4	2000/
40.	Opening found in working platform of scaffolding/floor	4	2000/
41.	Inadequate illumination at the working area	4	2000/
42.	Loose material lying on Gantry, platform	4	2000/
43.	Cleaning with Compressed Air.	3	500/-
44.	Gas Cylinders using without cap.	3	500/
45.	Gas Cylinders stored without securing	3	500/
46.	Bringing inside any other chemicals, apart from approved by Safety dept.	3	500/
47.	Using drum for sitting or accessing height.	3	500/
48.	Misusing emergency facilities like fire hydrant line/ hose box/ spray system/ eye wash etc.	3	500/
49.	No provision of Safety net where falling materials or tools may occurs	3	500/
50.	Taking electrical supply from non-designated outlet (other than socket).	3	500/
51.	Restricted gangways due to unwanted materials.	3	500/
52.	Not reporting incident.	3	500/
53.	Entering into restricted area like switch yard/ hazardous storage	3	500/
54.	Work without supervision	3	500/
55.	Parking of vehicle without applying wheel choke at right front-front and left rear-rear wheels other than passenger cars.	3	500/
56.	Heavy Vehicle without helper or co-driver.	3	500/
57.	Not wearing florescent safety jacket at site.	3	500/
58.	People travelling in load body of vehicle.	3	500/
59.	Parking of vehicles at non designated area.	3	500/
60.	Shifting heavy materials without guide ropes.	3	500/
61.	Using other than 24V lamp inside the confined space/Use of other than 24V lamps.	3	500/
62.	Angular loading/ lifting with Crane or hoist.	3	500/
63.	By passing the limit switch/ Safety Interlock.	3	500/
64.	Housekeeping activities on road without proper barricade.	3	500/
65.	Trying to board or alit from running vehicle.	3	500/

66.	Cylinder Valves of Gas cylinders not closed when not in use.	3	500/
67.	Flash-back arrester not used.	3	500/
68.	Hand Trolley wheel found damaged.	3	500/
69.	Guy ropes of required length on both sides of object are not used during movement with load.	3	5/ 00/
70.	Scotch block/wedge not provided, when the vehicle is parked.	3	500/
71.	Suitable Trolley not provided to hold the cylinders.	3	500/
72.	Locked First Aid box	3	500/
73.	Caution boards, danger signs (luminescent /red) along with emergency contact number are not found displayed.	3	500/
74.	Person found jumping barricading tape	3	500/
75.	Stacking of pipes, pile casing, drums without chock blocks/wedges	3	500/
76.	The terrain on which Heavy Equipment/Machinery moves is not reasonably hard.	3	500/
77.	Without Safety Helmet at working sites	4	250/-
78.	Without Crash Helmet (on bikes)	4	500/-
79.	Without Full body double lanyard Safety Harness (for work at height)	5	5000/-
80.	Without Hand gloves - Material Handling, Welding, Cutting,	4	100/-
81.	Without Safety goggles/ face shield - Welding/Cutting /Grinding	5	5000/-
82.	Handling Chemical without PVC Apron	5	5000/-
83.	Smoking in prohibited area (Closed Go-downs, Storage of flammable material, Storage of Gas cylinders)	5	1000/-
84.	Sleeping at Workplace	3	100/-
85.	Driving beyond speed limit	3	1000/-
86.	Seat Belt While Driving (for front seat passengers and driver)	3	500/-
87.	Driving without license	4	1000/-
88.	Heavy Commercial vehicles without reverse horn	3	500/-
89.	Nonfunctional Head light/ taillight and side indicators	3	100/-
90.	Using Mobile Phone During Driving	5	5000/-
91.	Poor visibility of registration number/ without registration number	3	100/-
92.	Broken/ without Side view mirror	3	100/-
93.	Over speeding above specified limit	3	500/-
94.	Broken/ Without Pressure gauge on Oxygen/ LPG / Acetylene cylinder.	3	500/-
95.	Without Flash back arrestor on Industrial Acetylene & Oxygen cylinders.	5	5000/-
96.	Spillage of hazardous material/chemicals during transportation	4	2000/-

97.	Electrical equipment without Earthing/ ELCB/ Double Insulation Cable.	5	5000/-
98.	Lifting Tools & Tackles used without/ expired Test Certificates.	5	5000/-
99.	Housekeeping repeatedly not maintained		
100.	• First Time	3	Warning
101.	• Second Time	4	1000/-
102.	• Third Time	5	5000/-
103.	Serious Violation of House Keeping (after 1st or 2nd warning to be decided by Project Manager depending on the severity)	5	Rs.10000/- and above
104.	Repeat Violation of same nature	5	5 X Penalty for Violation
105.	Appointment of subcontractor without his Safety Bid Evaluation and/or without the permission of engineer in charge or Order manager.	5	5% of Contract Value

Appendix 6: Process Flow Chart for issuing RFQ and PO



Appendix 7: CSM-F-7 Safety Competency Form (Template)

Name of the Vendor/Bidder : -

Name of the Sub Vendor (If job is given to Sub Vendor) : -

Description of the Job : -

Request for Quotation (RFQ) No. :-

Vendor/Bidder to mandatorily provide the below safety competency related information.

1. Proposed Manpower Deployment Schedule : -

Category of Manpower Deployed	Minimum Qualification & Experience	Proposed Numbers against each category month-wise			
		Month 1	Month 2	…	Month n
Project Manager					
Site-In-Charge (Site Manager)					
Shift-in-Charge					
Safety Officers					
Supervisors					
Technicians					
a……					
b……					
Highly Skilled Workmen					
a……					
b……					
Skilled Workmen					
Semi-Skilled Workmen					
Unskilled Workmen					
Total Manpower					

Instructions to Bidder to fill:

1. Bidder to provide the overall site manpower deployment schedule as above.
2. Bidder to indicate (through colour code mentioned below) their direct and sub-contracted employees

Direct bidder employee
Partly Direct / Partly sub-contracted
Sub-Contracted

3. Against each of the category, bidder to indicate the minimum qualification and experience of the proposed manpower.
4. Rows can be added to also identify other specialised manpower e.g. specific details to be included for high risk activities operators
5. Columns can be extended to the actual duration of Site activities.
6. Bidder to note that if operations is in shifts, then Shift-in-charge / safety officers are required for each shift of operation.

2. List of Tools, Tackles, Machines and Equipment: -

Bidder/ Vendor to provide the list of tools, tackles, equipment **to be used during the job / project execution**. Bidder/Vendor to ensure that all the lifting tools and tackles, pressure vessels are duly certified by the competent person authorised by the Chief Inspector of Factories of the respective state prior to start of the job

Sr. No.	Description of Tools / Tackles	Capacity / Rating	Quantity	Make	Remarks
1					
2					
3					
4					
5					
6					
7					
...					

3. Safety Records:

Bidder to provide the details of fatalities and lost workday cases (LWDC), occurred in last three years (data to be provided for the last completed FY and preceding 2 years).

Description	Safety Data for Last 3 Years		
	Year 1 (Last FY)	Year 2	Year 3
	20__ - __	20__ - __	20__ - __
Fatalities (Nos.)			
Lost Workday Cases (Nos.)			

In case of no fatalities, LWDC during any year, the form may be filled stating NIL against the respective year. Bidders are encouraged to also submit the RCA / incident investigation reports and the learning's implemented out of the above reported incidents

4. Job Safety Plan/ Method Statement:

Bidder to provide / enclose a detailed Site/Job Safety Plan along with a Method statement detailing the execution philosophy (how the bidder intends to execute the Job/Project), identifying all key activities which are required to be performed by the contractor at Site. Bidder to also list down all high-risk activities and provide the Hazard Identification and Risk Assessment (HIRA) for all such high-risk activities involved in the site work.

(Use Method Statement template attached as annexure A and sample as attachment B)

5. Management System Certification: -

Sr.	Certification	Yes / No	If Yes, Year of Certification	If No, Target date for Certification
	ISO 9001			
	ISO 14001			
	OSHAS 18001 / ISO 45001			
	Any other (please specify……			
Note: Please attach certificates to support above. In case not accredited for above but applied for, application letters may be attached.				

Appendix 8: CSM-F-8 PPE requirements

The Contractor shall ensure that the following PPE of Approved standards shall be available at all time and shall be used by his employees with no exception whatsoever.

1	All contractor's employees at site	Safety Florescent Jacket (orange color), Safety helmet & safety shoes with Composite or steel toe cap
2	Workers mixing asphalt, cement, lime / concrete	Safety goggle & protective Hand gloves and footwear, Nose mask.
3	Welders / Grinders	Welding screen/goggles, safety shoes, leather hand gloves, aprons, leg guard
4	Stone breaker	Protective goggle, hearing protection, anti-vibration hand gloves and Protective clothing.
5	Electricians	Rubber hand gloves & Electrical resistant shoes.
6	Workers engaged in insulation using glass wool etc.	Respiratory mask & leather Hand gloves, goggles.
	Workers engaged in coal handling plant, ash handling plant and working in high dust area.	Dust mask, Hand gloves, protective goggles.
7	Workers working at a height of 1.8 Meter or above.	Double lanyard full body harness, fall arrestor and safety net made of reinforced nylon fiber ropes firmly supported with steel structures

• **PPE shall be conforming to BIS/DGMS/DIN specifications, in good condition and shall be comfortable to his employees, when used.**

Appendix 9: CSM- F-10 Site Safety Management Plan / Method Statement

Site Safety Plan / Method Statement (Template)

This Method Statement describes the specific safe working methods which will be used to carry out the described work. It gives details of work procedure with control measures to counter health and safety issues related to this work. The listed content of this Method Statement can be changed/modified subjected to job scope / specifications, but task specific method statement once finalized & approved, that should not be modified during work execution without permission from the approving authority.

Project/Job Name			
Scope of work: -			
Drawing References: -			
Detail of Sub contractors involved: -			
Method Statement Prepared By: - Designation: - (e.g. Site Manager)		Signature	Date

1.0 Introduction (*Describe purpose of the work, give details of type and scope of work being carried out);*

2.0 Location of Work (*Give site address and precise location on site where work is to be carried out.)*

3.0 Safety Document /Specific Approval Required (Details of any safety documents or specific approval i.e. Client specific approval required to undertake the work)

5.0 Role & Responsibilities of Personnel/Parties Involved in activities: -Clearly define role and responsibilities of all personnel involved in activity i.e. Site management staff including subcontractors' parties- Main contractor Project/Site Manager, Sub Contractor Site Manager, Project Engineer, Safety officer, Competent Supervisory Staff)

6.0 Working/Activity Description: - It *is important that all operatives should have clear idea of those operational sequences and responsible supervisor must verify their competency prior to their engagement in operation.*

6.1 Pre-Working Checks

6.2 Resources (Equipment, tools including manpower) Details *i.e. Equipment and Tools, specific operational equipment, test kits, lifting resources, Details of materials to be used in operation, including any reference to COSHH assessments in case of use of any chemicals, Details of the manpower allocated to the task, e.g. titles, qualifications, competences, direct manpower, contractors. Details of plant, tools and equipment to be used for the work, including the availability of relevant statutory documents, checks or inspections etc. Details of fencing, barriers, cones, chains, dangers notices, warning signs etc.*

Tools required for work:

Sr.No	Tools /Equipment /Machine	UOM	Required Qty.	Remark
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

6.4 Operational Sequence of work: - *Full description of the work, setting out the methodology in a sequential manner, including any reference to any identified operational restraints. Also refer here sec. 5.0 responsibilities part for every step of work sequence).*

Sr.No	Activity	Details of job sequence	Risk Involved	Control Checks
1.		1.		
2.				
3				
4				
5.				

6.7 Final Checks & restoration of work area after completion of work :- *Those checks to be carried out by responsible supervisor in witness of his line hierarchy by use of specific checklist of certain operational checks and once those completed satisfactory, PTW (if applicable) to be closed and isolation arrangements to be restored by removing barricades/cautionary tags.*

7.0 Task Specific Hazards: - *Refer to Task Specific Risk Assessment and attach in appendix*
Attachment: - Specific Risk Assessment
In addition, please provide below control measures in risk assessment *(as applicable).*

Fall Protection Measures: (Where Work at height cannot be avoided)							
Control Measures for Electrical Hazards							
Others Hazard if any (please provide details)							
Hazardous Substances to be used in job : (Attach MSDS if required)							
	Yes /No	Yes /No	Yes /No	Yes /No	Yes /No	Yes /No	Yes /No

7.0 Emergency Provisions: -*Relevant operational possibility of a programme in the case of emergency situation i.e. electrical supply restoration. In addition emergency response provisions i.e. first aiders, fire fighting, and first aid arrangements, nearest onsite/offsite emergency response also to be considered during emergency planning.*

8.0 "5S issues" / Waste Disposal/ Housekeeping and Environmental issues: -*Details waste disposal processes and or housekeeping activities, Details of environmental impacts and control measures.*

9.0 Personal Protective Equipment (PPE):- (*Tick on PPE requirements for the task/Job*

Required Personnel Protective Equipment:	Safety Boots	Hard Hats	Safety Gloves	Hearing Protection	Eye Protection	Respiratory Protection	Other: 1. Hi-Viz 2. Coveralls 3.

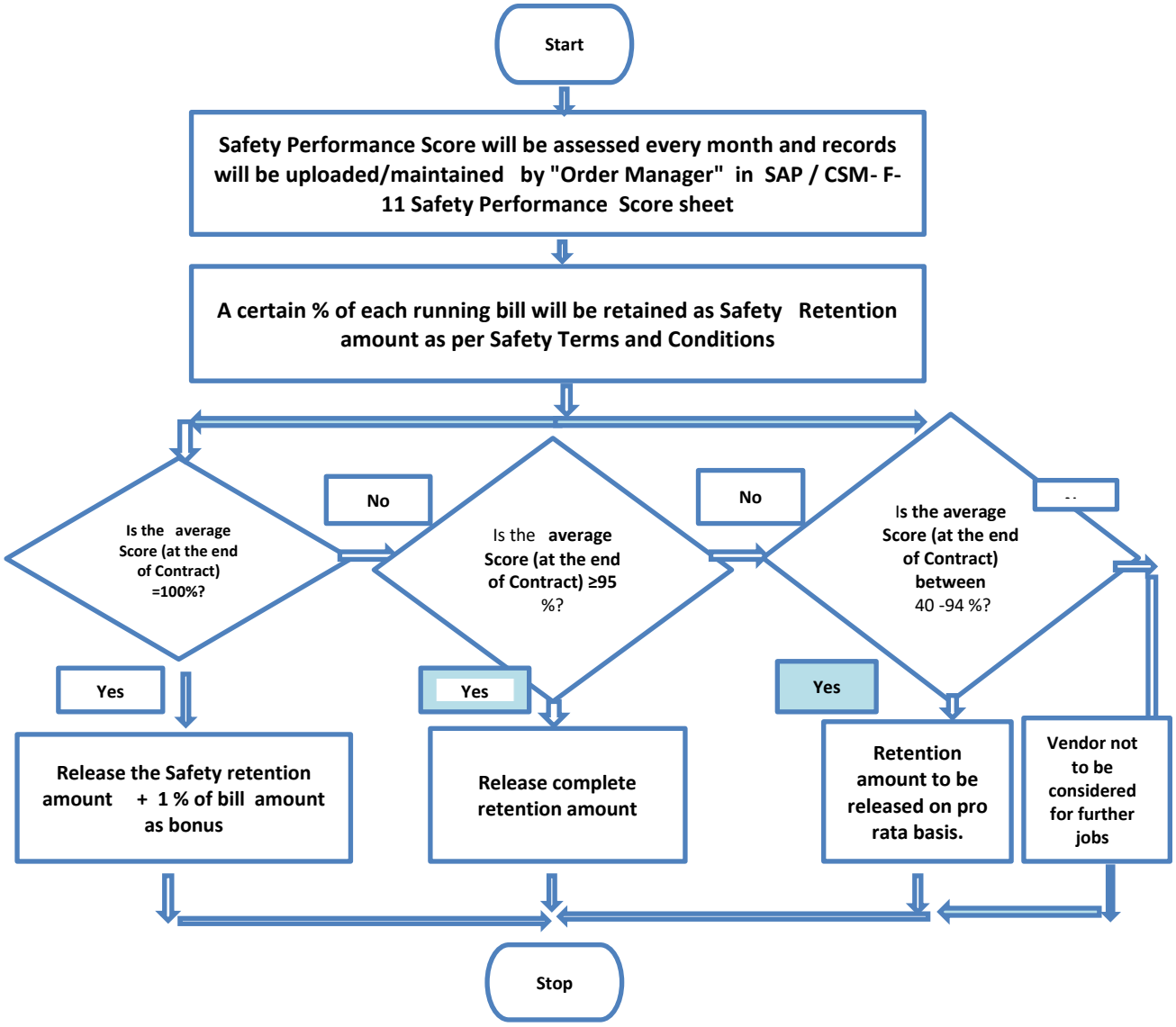
10.0 First Aid facilities and Nearby Hospitals Details

	First Aid Facilities:	Name of On-Site First Aider:	
		First Aid Box Location:	
		Location of Nearest Hospital:	

11.0 Occupational Health, Fitness and COVID-19 related Preparedness:

1. Please give a brief writeup / methodology of your organization planned to avoid impact of the COVID-19 pandemic at Tata Power working site. 2. Please give brief details of occupational health and hygiene related interventions planned by your organisation to ensure good health and fitness of workforce at Tata Power site.

Appendix 10: Process Flow Chart for Safety Performance Evaluation



Appendix 11: CSM- F-11 Safety Performance Score

Sr. No	Parameter	Unit of Measurement	Target	Weightage	Actual Performance	Actual Score
Lead Indicator						
1	% of Employee certified in TPSDI/Authorized agency	Number	50%	10		
2	CFSA score (Annexure 6.1)	Average Severity of Violations	1.49	20		
3	Monthly inspection completed for Critical Equipment, lifting Tools & Tackles and hand tools used at site	Number	80%	10		
4	Condition of critical tools, tackles and equipment	Number	100%	10		
Lag Indicator						
1	Number of Fatalities	No	0	30		
2	Number of Lost workday case (LWDC) (reportable)	No	0	10		
3	Man-days Lost	Man-days	0	10		
					Final Score	
					Invoice Value	
					Amount to be released	

Safety Performance Evaluation Criteria

Lead Indicators

	Target			
% of Employee certified in TPSDI/Authorized agency	50%	100%	Less than 100%	
Score		10	5	
	Target			
CFSA score	<=1.49	1.5 to 2.5	2.51 to 3.5	>=3.51
Score	20	15	10	0
	Target			
Monthly inspection completed for Critical Equipment, lifting Tools & Tackles and hand tools used at site	>=80%	79 to 50%	<50%	
Score	10	7	0	
	Target			
Condition of critical tools, tackles and equipment	100%	<100%		
Score	10	0		

Lag Indicators

Number of Fatalities	0	>0	
Score	30	0	
Number of LWDC (reportable)	0	>0	
Score	10	0	
Number of man days lost	0	1 to 5	>5
Score	10	5	0

Appendix 12: CSM-F-5 Safety Potential Evaluation Criteria for Vendor Registration

At the time of vendor registration, vendor will be registered under 3 categories

1) **Category A**- Vendors eligible to carry out High risk Jobs
2) **Category B**- Vendors eligible to carry out technical jobs that are low risk
3) **Category C**- Vendors eligible to carry out administrative and office jobs
4) **Category D**- Outsourced Jobs / Consultants /Medical Practitioners / Suppliers etc

For vendors to be registered under **Category A**, a safety potential evaluation will be carried out based on following parameters.

Sr. No	Description	Weightage (%)	Actual Score	Remarks
1	Does the contractor have a valid ISO 45001/ OHSAS 18001/ Certification?	30		
2	During site visit check for safety adequacy at site	30		Annexure - 12.1
3	Check the Safety statistics of Contractor	10		Annexure - 12.2
4	Check the Safety orientation & training process of Contractor	15		Annexure 12.3
5	Check the organizational structure for safety professionals & engineers / supervisors.	10		Annexure - 12.4
6	Certified/skilled workers as a percentage of overall workforce	5		
	Total	100		

Evaluation Criteria for Category B

Sr. No	Description	Weightage (%)	Actual Score	Remarks
1	Does the contractor have a valid ISO 9001 certification?	30		
2	During site visit check for safety adequacy at site	30		Annexure -12.1
3	Check the Safety statistics of Contractor	10		Annexure -12.2

4	Check the Safety orientation & training process of Contractor	15		Annexure -12.3
5	Check the organizational structure for safety professionals & engineers / supervisors.	10		Annexure -12.4
6	Certified/skilled workers as a percentage of overall workforce	5		
	Total	100		

Evaluation Criteria for Category C

Sr. No	Description	Weightage (%)	Actual Score	Remarks
1	Does the contractor have a valid ISO 9001 certification?	40		
2	Check the Safety statistics of Contractor	40		Annexure - 12.2
3	Check the Safety orientation & training process of Contractor	20		Annexure - 12.3
	Total	100		

Annexure 12.1: Evaluation Criteria for Category D:

Category D does not require any evaluation as it is for outsourced job outside the Tata Power company premise.

Annexure 12.2

Check List – Adequacy of Safety Statistics of Service Provider			Actual Marks obtained	Remarks
1	Check the safety statistics for last 3 years (LTIFR and LTISR)	Statistics available: Marks 5; Statistics not available: 0		
2	Check the trend LTIFR for last 3 years	LTIFR value: 0 to 0.2 – Marks 5; 0.21 to 0.3 – 2.5; >0.3 – 0		
3	Check the trend of LTISR last 3 years	LTISR value: 0 to 2 – Marks 5; 2 to 3 – 2.5; >3 – 0		
4	Has there been any Prosecution/Conviction for any contravention with regard to Safety & Health provisions under the Factories Act /Electricity Act/ BOCW Act and Rules framed there under?	No Prosecution – Marks 10; Prosecution – 0. To be provided in written on letter head		
	Total	25		

Annexure 12.3

Check List – Adequacy of Safety orientation & training process of Service provider			Actual Marks obtained
1	Records of safety trainings provided to safety officer/supervisor/workmen during last 1 year as percentage(%) of total employed by service provider	**Safety Officer** / Marks ≥80% of employees – 5 50 to 79 % of employee – 2.5 < 50% – 0 **Safety Supervisor** / Marks ≥80% of employees – 10 50 to 79 % of employee – 6 < 50% – 0 **Workmen** / Marks ≥80% of employees – 10 50 to 79 % of employee – 6 < 50% – 0	
	Total	25	

Annexure 12.4

Check List – Adequacy of organizational structure for safety professionals & engineers / supervisors.			Actual Marks obtained
1	Check availability of number of safety officers from government recognized institute as per workforce strength.	Marks 1 in 50 employees – 10 1 in 100 employee – 6 Any other – 0	
3	Check availability of qualified workforce from government recognized institute/TPSDI.	Marks 100% of safety officers qualified – 5 50 – 99% of safety officers qualified – 3 <50 – 0	
	Total	15	

Appendix 13: CSM-F-9 Safety Bid Evaluation Criteria.

The User has to select whether the job is high risk/ long duration at time of raising the PR.

1) The decision whether job is "**high risk** "or not has to be made by order manager on the basis of Risk involved (Risk Priority Number in HIRA) of the Jobs. An indicative list of high-risk jobs is attached as annexure
2) If a technical job is of low risk with estimated duration of the contract is 1 year or more the job should be treated as "**long duration**".
3) All Safety bids will be evaluated by Safety Concurrence Group. Structure of SCG will be declared by Corporate safety. Corporate safety team will audit bid evaluation process of a few selected jobs and Quality of evaluated safety Bids.
4) Records of jobs sent by for Safety Bid evaluation shall be maintained by Corporate Contract team in existing tracing sheet along with other jobs.
5) For Safety Bid Evaluation will be based on following parameters.

		Minimum Requirement	**Weightage (%)**	**Score Obtained**
Manpower	**Safety Officer (1 per 500 workers)**	**Qualification-** Officer shall possess Advance Diploma In Industrial Safety by state technical board. **Experience**- Minimum 1-year experience in relevant field as mentioned in the job in PR.	5	
	Safety Supervisor (1 per work site up to max. 50 workers)	**Qualification-** Supervisor shall possess ITI/ Diploma in relevant field. **Experience**- Minimum 2-year experience in relevant field as mentioned in the job in PR. **Training** – Trained and certified by TPSDI or equivalent institute in relevant safety procedures. **Note:** On request of the contractor/Users -TPDSI should vet & certify the skilled & experienced	5	

		Technician if Technical Qualification is not adequate.		
	Technician (Skilled workers as electrician, rigger, fitter, welder, cable jointer, line men etc)	**Experience**- Minimum 2 year experience in relevant field as mentioned in the job in PR. **Training** – Trained and certified by TPSDI or equivalent institute in relevant safety procedures.	5	
Tools & Tackles	Equipment / Machines/ Tools & Tackles(lifting and shifting tools)	The list of Equipment /Machines / Tools and tackles to be used for job to be submitted by the contractor. Evaluation of the list will be carried out based on 1) Suitability as per the relevant job 2) Make and age of the tools from authorized agencies defined by the user. 3) Certification by the competent authority of respective state.	30	
Safety Records	Safety Records	Safety Records for last 3 years (as per vendor or as per our knowledge) – Recommendation?	15	
Safety Plan	HIRA/Contract Job Safety Plan	Adequacy of HIRA and Job Safety Plan with respect to relevant job. More weight age will be given to vendor for using mechanized work and advanced tools and equipment	20	
Accredited Bodies certificate	ISO-9001	ISO-9001	2	
	ISO-14001	ISO-14001	3	
	OHSAS 18001 ISO 45000	OHSAS 18001/ISO 45000	15	
		Total Score		

6) Vendor entitled to carry out the job only when qualified for the safety evaluation as follows:

Contractor is qualified in safety bid only if his total score is more than 70% in all category 1 jobs such as high risk/long duration.

7) The Corporate Contract has to ensure that the vendor provides the filled "Safety Competency Form" along with the quotation.
8) Corporate Contract will forward the Safety Competency Form received from the contractor to the Safety Concurrence Group for evaluation.
9) In case SCG wants to visit the site, the Safety Competency will be based on evaluation at the time of site visit Annexure 13.1

Annexure -13.1:

Checklist to be used: During site visit to check the adequacy Safety systems.			
		Observation	Score* (1-5)
1	Check the adequacy of safety policy and Safety Management system of the contractor.		
2	Does the contractor have written down safety procedures?		
3	Check the records of Near miss, unsafe act, unsafe conditions and incidents.		
4	Check the organization setup to implement the safety systems at site (safety officer, safety supervisor)		
5	Check whether safety meeting and toolbox talk carried out regularly and records maintained or not.		
6	Is the process of incident investigation adequate or not?		
7	Verify incident reporting and recording system		
8	Check the usage of equipment/tools and tackles.		
9	Check for housekeeping at site		
10	Check the use of PPEs and general behavior of workforce towards safety		
	Total Score		
	Site Visit Score		

Score*- rating on the scale of 1-5 to be given based on the observations on site. Score of 1 is the lowest and core of 5 is the highest.

Appendix 14: CSM-F-11.1 CFSA Format

CONTRACTOR FIELD SAFETY AUDIT

Project Name :

Date:

Description of Severity rating:		**Audit Team:**	
	1 = Untidy area, minor issues, sets poor example		
	2 = Restricted access, unacceptable trash, disorderly		
	3 = Rule or procedure violation, potential injury		
	4 = Unsafe condition, serious injury potential		
	5 = Immediate serious injury potential, stop activity immediately and correct	**Audit Time:**	10:00hrs -11:30 hrs
		Weather:	cloudy

	Description	**Responsible**		**Number Personnel Observed**		**Violations**			**Remarks**	Leading Indicators			
		Engineer	**Contractors**	**Good Citizens**	**Violators**	**Number of Violations**	**Severity**	**Violations x Severity**		4 & 5	PPE	Unsafe Act	Unsafe Condition
Area													
1													
	Sub Totals			**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**
	% of Observed People Working Safely												
	Number of Violations												
	Average Severity of Violations												
	Number of Severity 4 & 5 Violations												
	% of 4 & 5 Violations												
	Approximate Number of Workers Observed												
	Number of People on Site												
	% of Workers Observed												

Appendix 15: Indicative List of High-Risk Jobs

To access the exhaustive list of High-risk jobs, please refer the following documents

1) High Risk Jobs- Generation
2) High Risk Jobs- T&D
3) High Risk Jobs- Renewable

Indicative List of High-Risk Jobs -Generation Cluster					
Sl. No.	**Jobs**				
1	Demolition / Painting of Chimney				
2	Survey Sounding Jobs in Sea				
3	Dredging at Coal Birth Jetty				
4	Maintenance / Testing and Replacement of Extra High Voltage (132 KV etc.) Switchyard equipment				
5	Maintenance of EOT Cranes				
6	Deep excavation (5 feet or more) near existing buildings /Structure s				
7	Working inside confined spaces (entry through manhole)				
8	Operation Maintenance of elevators				
9	Working on Live control Circuits for identification of faults				
10	Cable laying and termination Jobs				

Indicative List of High-Risk Jobs - T&D Cluster					
Sl. No.	**Jobs**				
1	Transmission Line Tower Erection on columns, near live lines, In congested areas, In creeks, In the Sea				
2	Conductor Stringing on Tower Using Tensioner & Puller in the area such as Line Crossing, Near Live lines, Congested Areas, Road Crossing, Bridge Crossing, Railway line Crossing, In creeks ,In the Sea				
3	Cable Pulling by Using winch Machine in City and Rural Areas				
4	Hot Washing of HT and Extra HT lines, Towers and switchyards equipment				
5	Installation of Lifts				
6	Installation of EOT Cranes				
7	Tower Dismantling				
8	Working on H Frame /Pole mounted Transformers				
9	Excavation in operational Area heaving power cables in receiving station				
10	Identification and spiking of cable / disconnection of cables from poles				

Indicative List of High-Risk Jobs - Renewable Cluster					
Sl. No.	**Jobs**				
1	Working on Electrical Panels				
2	Hi Potting of Equipment				
3	Battery commissioning and maintenance				
4	Working on the nasal of Wind Turbine				
5	Working on live electrical switchyard, material Handling and Equipment installation				
6	Roof Top Solar Panels Installation and maintenance				
7	Working in live Electrical Switchyard, Material Handling, equipment installation				
8	All maintenance activities that requires climbing on Towers /Structures / Transformer/ GODs				
9	Loading and Unloading of Solar Panels on trucks				
10	Structural Repair /Dismantling work at height.				

Heavy Equipment Movement Safety Procedure

Rev No.	Reason for Revision	Prepared By	Checked By	Approval by
Rev 00	First release	R&P Subcommittee	D Kamath	Vijay Chourey
Rev 01	Standardization of procedure	Arnav Mukherjee (Head - EMD & IMD Haldia)	Navendra Singh (Group Head – P & CB; Corp Safety.)	Vijay Chourey (Chief – Corp Safety)

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1. OBJECTIVE:

Objective of this procedure is to cover the safe practices required for heavy equipment lifting and movement. This procedure is developed to establish mandatory requirements for practices to protect personnel from hazards associated with heave equipment movement activities.

2. SCOPE:

This procedure applies to all operating plants and project sites of Tata Power Group companies.

3. EXPECTED RESULTS:

3.1. Manage jobs related to Heavy Equipment movement being done safely.
3.2. Control of incidents related to Heavy Equipment movements.
3.3. Compliance to Regulatory requirements related to Heavy Equipment Movement.

4. ACCOUNTABILITY & RESPONSIBILITY:

4.1. ACCOUNTABILITY: Concerned Division's Heads/Assets Custodian.
4.2. RESPONSIBILITY: Concerned Engineer/s

5. GLOSSARY/ DEFINITIONS:

Approver: Location Manager in charge of plant/dept. Authorized shall be as Per the permit to work procedure.

Attachment description - List type of slings; belts, wire ropes, chains, shackles etc. to be used to attach the load, if required make a simple sketch under lift description.

Anti-two-blocking device - a device that, when activated, disengages all crane functions whose movement can cause two-blocking.

Abnormal operating conditions—Environmental conditions that are unfavorable, Harmful, or detrimental to the operation of a mobile crane (e.g., excessively high or low ambient temperatures, exposure to weather, corrosive fumes, dust-laden or Moisture-laden atmospheres, and hazardous locations).

Competent Person - One who, by possession of a recognized degree, certificate, or professional standing and certified by government authority.

Critical lift—A lift using an Mobile crane where, because of the characteristics and properties or travel path of the load, a hoist failure or loss of control of the load could result in a serious personal injury, serious environmental incident, serious process safety incident, or significant disruption to operations.

Capacity loading - It will be calculated by dividing the total weight with the safe workload at lift radius. It shall not exceed 85%. For capacity loading above 85% a lifting plan is required. No capacity loading above 100% shall be allowed, equal to 90% of load test. If Safe Load Indicator is not installed the capacity loading shall not exceed **60%;** if above a lifting plan is required. For lifting personnel the capacity loading must be below 50%.

Eccentric Load - Load center of gravity does not correspond to the geometrical center, e.g. an unevenly loaded container. In case of eccentric load for heavy loads, say above 2 T, center of gravity should be calculated and lifting points defined accordingly. For light loads the most practical is to determine the center of gravity by trial and error without lifting the load completely off the ground.

Hazard Identification & Risk Assessment - Hazard Identification & Risk Assessment is to identify and evaluate the hazards, Risk and put controls measures for safe execution of activities.

Hazard - Source or situation with potential for harm, something that can cause body injury / occupational illness, damage company property.

HIRA - Hazard Identification and Risk Assessment

Intended load = Dead load + Live load + wind load + Dynamic load.

Job - A piece of physical work defined by time or other limits and that has a clear start and end point.

JSA - Job Safety Analysis

Job Safety Analysis: Job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job. In a JSA, for each basic step of the job, it is to identify potential hazards and to recommend the safest way to do the job.

LEL - Lower Explosive Limit

LOTO - Lock Out Tag out

Load - Weight of load can be from equipment data sheet, marking on packing, marking on pipe spool, calculation (add 15% allowance for inaccuracies) or weighing. Guessing the weight of the load is not allowed. Crane user shall maintain record of how the weight was derived until the lift is successfully completed.

Length x Width x Height (LxWxH) - Is required for bigger equipment for deciding lifting radius and lifting height. For bigger surface, say above 25 m2, also wind loads need to be considered. For small pipe spools, valves etc. this data is not required.

Lift Radius - Maximum horizontal distance between the point at which the center of crane rotation meets the ground and the vertical centerline passing through the load lifting attachment.

Lift Height - The height above the setting of the crane that the load must be lifted to. To derive at the boom height the length of hook, slings and load must be added as well as some free space above any equipment the load will be slew over.

Non Routine Job / Task: Where an SOP / SMP is not available or the conditions of the SOP / SMP have changed

PPE - Personal Protective Equipment

PTW - Permit to Work

Periodic Inspection - Detailed safety and maintenance inspection performed by a qualified person to verify compliance with the provisions of legal requirements.

Risk - The likelihood (probability) which can lead to potential negative consequences.

Risk Assessment - A systematic and structured process whereby hazards present in a workplace, or arising from workplace activity, are identified, risks assessed / evaluated, and decisions prioritized in order to reduce risks to acceptable levels.

Rated load (capacity) - the maximum load designated by the manufacturer for which an individual hoisting system component is designed and built.

Shall - Mandatory requirement

Should - Optional requirement

SHE - Safety, Health and Environment

Severity - The level of consequence / harm of an event that could occur due to exposure to the hazard present.

SWL - Safe working load

Safe Workload at lift radius - Will be derived from the selected Crane Load Chart for the calculated lift radius and boom length. Adjustment shall be done in relation to valid load test and only 85% of the load test value shall be considered as safe workload.

SLI - Safe Load Indicator, it is a system which cut-off all the unsafe crane operations if overloaded and anti two blocking comply.

Safe access route - to the place for the crane set up shall be checked with SS or SFE. Ensure that ground can carry the load of the crane. If soil is soaked with water the loading capability is significantly reduced. Check for underground cables and pipes as well as vicinity to any above ground obstructions like fire hydrants, firewater valves and pits. Ensure that trailer bringing the load also has a safe access, not blocked by the intended set up of the crane.

Standard lift - If load to be lifted weighs less than 15 ton, it is a standard lift. The crane user is required to complete “Mobile Crane Planning & Risk Assessment Checklist”.

Two-blocking - The condition in which the lower load block or hook assembly comes in contact with the upper load block or boom point sheave assembly. (Condition under which the load block or load suspended from the hook becomes jammed against the crane structure preventing further winding up of the hoist drum).

Total weight - It is the sum of the weight of the load and weight of hook block, slings and attachment.

Task / Activity - A sequence of steps taken to conduct a job. A task is a sub element of a Job.

Weight of hook block, slings and attachments shall be derived from crane load chart and tables for slings.

6. PROCEDURES:

6.1. Manual hoisting systems: This section describes the safety features for all new and existing manually powered chain hoists and lever-operated hoists.

6.1.1. New Manual Hoisting Systems Installation: All new manual hoisting systems shall meet the following mandatory requirements:

6.1.1.1. **Rated Load** - The rated load shall be marked on each hoist or lifting device and on the trolley if the hoist is hook-mounted (i.e. easily detached). These markings shall be clearly legible from the operating floor.

6.1.1.2. **Load Test –** The initial load test of manual hoisting systems will be 1.5 times the rated load. All subsequent tests of new hoisting systems and hoists with modified or altered load-suspension parts shall be load-tested before being placed in normal service. The load test shall not be less than 100 percent or more than 125 percent of the rated load unless recommended by the manufacturer or a competent person or regulatory requirements.

6.1.1.3. **Overload Limiting Devices** - Chain hoists and lever-operated hoists used for overhead lifting or drifting of loads shall be equipped with automatic overload devices to prevent lifting over capacity loads. The overload limiting device shall not exceed load test limit of the hoist's capacity. Lever-operated hoists shall have either a slip clutch overload limiting device or an overload-sensing lever handle.

6.1.1.4. **Load brakes** - Chain hoists and lever-operated hoists used for overhead lifting or drifting shall be equipped with an independent mechanical load brake to control the lowering of the load and to stop and hold a rated load. For lever-operated hoists, simple ratchet-and-pawl type brakes shall not be used for hoisting applications because of the risk of sudden or uncontrolled load drop if the ratchet-and-pawl mechanism fails.

6.1.1.5. **Trolley Safety lugs/rail sweeps** - Where hoists are mounted on trolleys, the trolley shall be equipped with safety lugs/rail sweeps, which protect against load drop in the event of wheel axle failure.

6.1.1.6. **Roller chain and wire rope hoists** - Roller chain hoists and wire rope lever-operated hoists shall not be used in overhead hoisting systems.

6.1.2. Existing manual hoisting systems, installation

6.1.2.1. With the exception of overload-limiting devices, all existing manual hoisting systems shall meet all mandatory requirements for new systems. Existing hand-operated chain hoists not equipped with an overload-limiting device shall only be used under the following conditions:

6.1.2.1.1. The hoist shall be used under strict administrative controls that prohibit the hoist from being placed in any over-capacity condition.

6.1.2.1.2. The hoist shall be labeled with a permanent tag to indicate the absence of an overload-limiting device.

6.1.2.1.3. The hoist shall not be used to conduct a critical lift.

6.2. Electrical and Air Powered Overhead Hoists and Cranes:

This section describes safety features for all new and existing, overhead-supported, Powered hoists.

6.2.1. New electrical and air-powered hoisting Systems Installation

6.2.1.1. All new electric and air-powered hoist and crane installations must meet the following mandatory requirements. For precise movement and control two speed hoists shall be used.

6.2.1.2. ***Rated load*:** The rated load shall be marked on each hoist or lifting device and on the trolley if the hoist is hook-mounted (i.e., easily detached).These markings shall be clearly legible from the operating floor and markings shall be on both sides for top-running cranes.

6.2.1.3. ***Load test*:** All new hoisting systems and hoists and cranes with modified or altered load-suspension parts shall be load tested. The initial load test of electric or air powered hoisting systems will be 1.5 times the rated load. All subsequent load tests shall not be less than 100 percent or more than 125 percent of the rated load unless otherwise recommended by the hoist manufacturer or a competent person or regulatory authorities.

6.2.1.4. ***Overload limiting device***: Powered hoists shall be equipped with an overload-limiting device to prevent the hoist from lifting over-capacity loads. The overload limiting device shall not exceed the test load limit of the hoist's rated load for electric/electronic load cell or mechanical devices. For air-powered hoists, this mandatory requirement for an overload-limiting device can be satisfied if the hoist is equipped with an air motor that shall not exceed of the rated load at standard operating pressure.

6.2.1.5. ***Dual braking system***: Powered hoists shall be equipped with dual braking systems. All hoists must be equipped with a primary brake. A second braking system shall be one of the following:

6.2.1.6. An independent mechanical load brake that controls the lowering of the load and stops and holds a rated load if the primary brake fails;

6.2.1.7. Self-locking worm gear (40:1 ratio), which acts as an additional braking system because the self-locking worm feature acts as a holding brake.

6.2.1.8. Trolley safety lugs/rail sweeps: Trolleys and crane end trucks shall be equipped with safety lugs/rail sweeps to prevent the load from dropping if the trolley or end truck wheel axle fails.

6.2.1.9. Roller chain: Roller chain hoists shall not be used for overhead hoisting systems.

6.2.1.10. "Dead man" controls: All powered hoists and cranes shall be equipped with "dead man"- style controls that, when released, return to the off position and stop powered motion.

6.2.1.11. Clearly marked control station device: All pushbuttons shall have clear, legible markings to indicate all control station equipment functions.

6.2.1.12. Upper final limit device: All wire rope hoists shall have an upper final limit device to stop the upward hoisting motion beyond safe limits. For electric powered wire rope hoists, this upper final limit device is typically a weight or paddle upper limit switch. This switch shall be connected to open the mainline contactor in the motor feed circuit. A reset button must bypass the limit switch contact to provide the means of re-closing the contactor. This reset button shall immobilize the upward motion and allow the load to be safely lowered. It is preferred that the reset button be located in the control enclosure.

6.2.1.13. Over-travel protection: All chain hoists shall be designed and constructed so that the load hook shall not exceed the upper limit of travel.

6.2.1.14. Geared limit device: All powered wire rope and chain hoists shall be equipped with geared limit devices that prevent over travel while either raising or lowering the hook or load.

6.2.1.15. If an air-powered chain-hoist is equipped with physical chain stops that prevent chain over travel and a load-limiting device, then geared limit devices are not required. A permanent tag indicating the absence of a geared limit device shall be attached to any hoist without geared limit devices.

6.2.1.16. Trolley and crane bridge travel limit devices: Motorized trolleys and motorized crane bridges shall be equipped with travel limit devices to stop travel motion before the trolley or bridge strikes the end stops.

6.2.1.17. Mainline contactor: Electric powered hoists and cranes shall be equipped with a magnetically operated mainline contactor that interrupts power to all motors and is energized from the pendant pushbutton station. Momentary pressure on the Push button shall de-energize the mainline contactor.

6.2.1.18. Electrical grounding conductor: Electric hoists shall have a dedicated electrical grounding conductor in the electrification and control system to positively ground or earth all equipment.

6.2.2. Existing electric and air-powered hoisting systems, installation

6.2.2.1. All existing electric and air-powered hoist and crane installations must meet either the mandatory requirements for new installations.

6.2.2.2. If an electric chain hoist has a defective or damaged mainline contactor or if an electric powered hoist has a defective or damaged geared limit device or if any.

6.2.2.3. hoist does not have operable dual brakes (e.g. one brake is defective or damaged), then the following steps must be done:

6.2.2.4. Operator or Field Engineer must notify the Site/Project Manager of the abnormal condition immediately.

6.2.2.5. The damaged or deficient hoist or crane shall not be used. The damaged or deficient hoist or crane must be repaired and verified by field engineer.

6.2.2.6. Mainline contactor (chain hoists) administrative controls – All existing electric chain hoists without slip clutch overload protection shall be retrofitted with a mainline contactor circuit. All electric chain hoists with slip clutch overload protection, but without a mainline contactor, shall be equipped with a permanent tag indicating the absence of the mainline contactor.

6.2.2.7. Any electric chain hoist with slip clutch overload protection, but without a magnetic mainline contactor circuit, shall have an electric powered manual disconnect switch that is within sight of the hoist and accessible to the operator.

6.2.2.8. Administrative controls shall be employed to help ensure that the operator knows the location of the manual disconnect switch.

6.2.2.9. Mainline Contactor: Electric powered hoists and cranes shall be equipped with a magnetically operated mainline contactor that interrupts power to all motors and is energized from the pendant pushbutton station. Momentary pressure on the Push button shall de-energize the mainline contactor.

6.2.2.10. Geared limit device administrative controls - All electric powered hoists without geared limit devices shall employ administrative controls to help ensure that the upper final limit device or over travel protection is not used as a routine upper travel limit. A permanent tag indicating the absence of a geared limit device shall be attached to the hoist.

6.2.2.11. Dual brake deficiency - All hoists without an approved secondary braking system shall employ administrative controls to prevent the hoists from being used in critical lifts in which an uncontrolled load drop could cause a serious injury or incident. These hoists shall be equipped with a permanent tag indicating the absence of a secondary braking system. The administrative procedures are meant to keep personnel away from the load during hoisting operations and prevent the hoist from being used for critical lifts.

6.3. Overhead Hoisting Monorails Installation:

Important safety features for overhead hoisting monorails include the following:

6.3.1. Monorail end stops - All monorails shall have permanent end stops provided at the extremes of hoisting equipment travel.

6.3.2. Switches, turnarounds, lift sections, and other monorail track ends shall be provided with automatic safety stops to prevent trolleys from rolling off open ends.

6.3.3. Where a section of track must be opened to allow for the closing of fire doors, automatic track openers shall be provided. These devices must be so constructed that the closing of the door (i.e., manually or because of a fusible link's parting) opens the track and allows the door to close tightly. Track safety stops shall be automatically placed and retracted as the track is opened and closed.

6.3.4. Monorail extension modification - Whenever a monorail is extended, it shall be designed to carry the design load of the original system. The track sections must be compatible to help ensure that the trolleys do not slip off the different track sections.

6.3.5. Rated load markings - The rated load shall be marked on the monorail, and the markings shall be clearly legible from the operating floor. For lifting lugs that support hoisting equipment, the rated load shall be marked on the lug or in close proximity to it and shall be clearly legible from the operating floor.

6.3.6. Load test - All new monorails and recently modified or altered monorails shall be load-tested before being placed in normal service. The initial load test of the monorail will be 1.5 times the rated load. All subsequent load tests shall not be less than 100 percent or not more than 125 percent of the rated load unless recommended by the manufacturer or a qualified person.

6.3.7. The load test must be in line with the requirements of the statutory agency.

6.3.8. Multiple hoists on a single monorail - If multiple hoists are used on a single monorail, the sum of the hoist capacities should not exceed the marked monorail rated load. Where this is impractical, strict administrative control and proper hoist operating instructions shall be provided to prevent overloading of the monorail.

6.4. Inspection:

6.4.1. Initial inspection: Prior to initial use, all new, reinstalled, altered, or modified overhead hoisting systems shall be inspected by the Competent person to verify compliance with the applicable provisions of this standard. Records of inspections shall be maintained.

6.4.2. Inspection procedure for overhead hoisting systems: The inspection frequency for overhead hoisting systems in regular service is divided into two general classifications based on the service frequency of the hoist or crane.

The service frequency affects the nature of the critical components of the hoisting system and the degree of their exposure to wear, deterioration, or malfunction.

6.4.3. Inspections shall be done by the operator at prior to use every day.

6.4.4. Inspections shall be done by competent person every year as per legal requirements.

6.4.5. Preventive Maintenance: A preventive maintenance program shall be established and based on the equipment manufacturer. Dated records should be kept. Replacement parts shall be, at least, equal to the original manufacturer's specifications.

6.4.6. Maintenance procedure: Before adjustments and repairs are started on a hoisting system, the following precautions shall be taken:

6.4.6.1. If a load is attached to the hoisting system, it shall be removed.

6.4.6.2. If the hoisting system is electrical- or air-powered, all controllers shall be placed in the "off" position.

6.4.6.3. If the hoisting system is electrical- or air-powered, a lockout/tag out procedure shall be performed.

6.4.6.4. Any crane or monorail carrier shall be moved to a location in which it causes the least interference with other cranes or carriers on the system and operations in the area.

6.4.6.5. Effective warning signs and barriers shall be used where the maintenance work creates a hazardous area on the floor below the hoisting system.

6.4.6.6. Where other cranes or carriers are in operation on the same runways or monorail track, rail stops or a signal person shall be provided to prevent contact with the idle equipment.

6.4.6.7. Where runways are adjacent to the crane runway of the crane being repaired, and the center runway or center repair platform, or both becomes a work area that is not protected by wire mesh or other suitable protection, or if any hazard from the adjacent operations exists, the adjacent runway must also be restricted.

6.4.6.8. When cranes must operate on adjacent runways and through the restricted area, a signal person shall be provided.

6.4.6.9. All cranes shall come to a full stop prior to entering the restricted area and then are permitted to proceed through this area on a signal from the signal person.

6.4.6.10. If the hoist is suspended from a trolley, provisions should be taken to prevent movement of the trolley.

6.4.6.11. After adjustments and repairs have been completed and before the hoist is restored to normal operation, the following steps shall be taken:

a. Guards shall be reinstalled.

b. Safety devices shall be reactivated.
c. Parts that have been replaced and loose material shall be removed.
d. Maintenance tools (including hand tools) and equipment shall be removed.
e. Warning signs and barriers, when used, shall be removed.
f. Warning signs and barriers, when used, shall be placed and removed only by designated persons.

6.5. Operation:

6.5.1. Operators of overhead hoisting systems: Hoisting systems shall be operated only by the following personnel:

a. Qualified operators,
b. Maintenance and test personnel, when hoist system operation is performed as part of their duties and they are qualified operators,
c. Inspectors of hoisting systems who are qualified operators.

6.5.2. Operators shall attend formal training or instructions on the operation of the specific hoisting device or crane. Attendance shall be recorded. Operators shall be required to pass a practical operating examination. The practical operating examination must include actual operation of the specific hoisting device or crane in the presence of an experienced supervisor or qualified person who will verify the competence of the operator under examination. Successful "pass" of the examination shall be recorded. Failure requires repeat training and re- examination until "passing" mark is obtained.

6.5.3. Qualifications shall be limited to the specific type of equipment for which the operator was examined and passed. If an operator has not operated a specific type of equipment in the previous 12 months, he or she shall be re-qualified.

6.5.4. Before operating a hoisting system

6.5.4.1. The operator shall be familiar with all operating controls including remote control unit of the hoisting system and be instructed in the operation(s) to be performed. Instructions shall include, as applicable, the warnings on the hoist, the hoisting practices listed in this section, and the operation instructions portion of the manufacturer's manual.

6.5.4.2. If adjustments or repairs are appropriate or any defects are known, the operator shall report this promptly to the designated person.

6.5.4.3. The following restrictions shall be observed:

6.5.4.3.1. The operator shall not operate a hoisting system that bears an out- of-order or "do not operate" sign.

6.5.4.3.2. The operator shall not adjust or repair a hoisting system unless qualified to perform maintenance on it. Only a qualified maintenance person from OEM (Original Equipment Manufacturer) shall perform repairs to a hoisting or crane system.

6.5.4.3.3. The chain or rope shall not be used as a ground for welding.

6.5.4.3.4. A welding electrode shall not be touched to the chain or rope.

6.5.4.3.5. Hand-chain-operated hoists shall only be operated with hand power with no more than one operator operating each hand chain.

6.5.4.3.6. Manually operated lever hoists shall not be operated with an extension on the handle.

6.5.5. Applying the load: The following mandatory requirements shall be in effect when the load is applied:

6.5.5.1. The hoist rope or chain shall not be wrapped around the load.

6.5.5.2. The load shall be attached to the load hook by suitable means.

6.5.5.3. The sling or other device shall be properly seated in the base (i.e., bowl or saddle) of the hook. The hook latch shall not be allowed to support any part of the load.

6.5.5.4. The load shall not be applied to the point of the hook.

6.5.5.5. Before moving the load, the operator shall ascertain that chains or wire rope are not kinked or twisted or that multiple part chains or ropes are not twisted about each other.

6.5.5.6. The hoist shall not be operated unless the rope or chain is seated properly on the drum, sheaves, or sprockets.

6.5.5.7. Hoisting systems shall not be operated unless the hoist unit is centered over the load, except when authorized by a qualified person who has determined that the components of the hoist and its mounting would not be overstressed. If a load that is not centered under the hoist unit is to be picked up, precautions shall be taken to control the swing of the load when it is picked clear of its supports.

6.5.5.8. The operator shall not pick up a load in excess of the rated load for any of the individual hoisting system components (hoist, trolley, monorail, crane, lifting lug). A hoist overload-limiting device shall not be used to measure the maximum load to be lifted.

6.5.5.9. Specific attention should be given to balancing of the load and hitching or slinging to prevent slipping of the load.

6.5.6. Moving the load: The following mandatory requirements shall be observed when moving a load.

6.5.6.1. The operator shall not engage in any activity that diverts the operator's attention while operating the hoist. The operator shall be focused only on proper lifting operation.

6.5.6.2. The operator shall respond to signals from the designated person only.

6.5.6.3. However, the operator shall obey a stop signal at all times, no matter who gives it.

6.5.6.4. The operator shall not lift or lower a load with the hoist until the operator and all other personnel are clear of the load.

6.5.6.5. The operator shall be very clear about the path of the load to be travelled .Any obstruction in the path shall be identified and removed before starting movement of the load

6.5.6.6. The operator shall determine that there is adequate clearance between the load and hoisting system and all obstacles before moving or rotating the load.

6.5.6.7. The operator shall inch powered hoists slowly into engagement with a load. The operator should minimize inching and avoid quick reversals of direction.

6.5.6.8. A load shall not be lifted more than a few inches until it is well balanced in the sling or lifting device.

6.5.6.9. The place where the load is going to park should be checked for its levelness and strength in order to avoid imbalance while parking either in the vehicle or ground.

6.5.6.10. Each time a load approaching rated load is handled, the operator shall check hoist brake action by lifting the load clear of supports and continuing only after verifying that the brake system is operating properly.

6.5.6.11. On rope hoists, the load shall not be lowered below the point where less than two wraps of rope remain on each anchorage point of the hoist drum, unless a lower limit device is provided. In this case, no less than one wrap should remain on each anchorage point of the hoist drum.

6.5.6.12. The operator shall not carry loads over people at any time.

6.5.6.13. Personnel shall not be carried on the hook or the load at any time.

6.5.6.14. The operator shall avoid swinging the load or load hook when traveling the hoist.

6.5.6.15. On trolley mounted hoists contact between trolleys or between trolleys and stops should be avoided.

6.5.6.16. The operator shall not use the upper (or lower, if provided) limit device(s) as a normal means of stopping the hoist. These are emergency devices only.

6.5.7. Parking the load:

6.5.7.1. The operator shall not leave a suspended load unattended.

6.5.7.2. The load block should be positioned above head level for storage when not in use.

6.5.7.3. Care shall be exercised when removing a sling from under a landed and blocked load. The person who is removing the sling shall protect himself with appropriate PPE and position himself to avoid being struck or pinched by the sling.

6.5.8. Limitations on Lifts: Lifts in excess of the rated load shall not to be performed at any time.

6.5.9. Critical lifts: Every critical lift shall have a completed critical lift plan. Critical lift best practice for overhead crane equipment is attached in Annexure - 1.

7. Records:

7.1. Daily/Periodic Hoist/Monorail Inspection Forms (TPSMS/CSP/HEMS/005/FORM001, 002 & 003) - Retention - One (1) years

7.2. Annual Checklist / Form filled by competent person as per Factory Act - Retention – Three (3) years

8. Training & Communication:

8.1. Training of Heavy Equipment Movement Safety procedure shall be carried out to cover for following-

a) Operator
b) Rigger & Signalman

8.2. Initial Communication to be done through Corporate Communication, Email and subsequently shall be made available at safety portal at Sangam.

9. VERIFICATION

9.1. Verification of implementation shall be done during Heavy Equipment Movement Safety procedure audit, field safety visit and site inspections.

10. Exceptions: Any Exception to this procedure shall only be done as per Document Control .Procedure (TPSMS/GSP/DC/014)**.**

11. REFERENCES

- Indian Factory Act 1948 and State Factory Rules
- Permit-To-Work Procedure : (TPSMS/CSP/PTW/008)
- Job Safety Analysis (JSA) Procedure : (TPSMS/CSP/JSA/009)
- Hazard Identification & Risk Assessment (HIRA) Procedure : (TPSMS/GSP/HIRA/005)
- Lockout/Tag out Standard and Procedure : (TPSMS/CSP/LOTO/001)
- American Society of Mechanical Engineers (ASME) B30.2-2001, Overhead and Gantry
  Cranes—Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist
- ASME B30.11-1998, Monorails and Underhung Cranes
- ASME B30.16-1998, Overhead Hoists (Underhung)

- ASME B30.17-1999, Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Under hung Hoist)
- ASME B30.21-1999, Manually Lever-Operated Hoists

12. **Review:** Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in Incident investigation reports may be inputs for the review and revision of the procedure.

13. **ATTACHMENTS/APPENDIX :**

13.1. Annexure 1- Critical lift best practice for overhead crane equipment.
13.2. Annexure 2- Overhead Crane pre-operational checklist (TPSMS/CSP/HEMS/005/FORM001)
13.3. Annexure 3- Crane Periodic inspection report format – Mechanical Items (TPSMS/CSP/HEMS/005/FORM002)
13.4. Annexure 4- Overhead crane Periodic inspection report format – Electrical Items (TPSMS/CSP/HEMS/005/FORM003)

Annexure – 1

Critical Lift best Practice for Overhead Crane Equipment

Purpose

The purpose of this best practice is to provide guidance to help ensure safe lifting of loads over critical equipment.

References

Heavy Equipment Movement

Principles

Live service lines and process equipment are vulnerable to damage if suspended loads are dropped on them. Use of proper hoisting equipment, and correct rigging and lifting practices to maintain control of the hoisted load will ensure the load is not dropped.

Definitions

Critical lift - a critical lift is a lift where a load suspended from an overhead lifting device travels over live equipment containing high hazard process and the potential exists to cause a release of the process and/or significant downtime, if the load were to become uncontrollable and drop.

Competent person - one by way of training and/or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the employer, and has the authority to take appropriate actions.

Designated person - one selected or assigned by the employer or employer's representative as being competent to perform specific duties.

Frequent inspection - visual examinations of hoisting equipment by the operator or other designated person with records not required.

Periodic inspection - visual inspection of hoisting equipment by a designated person who makes records of external conditions to provide the basis for a continuing evaluation.

High hazardous process – any process that falls within the definition of HHP (High Hazard Process) as defined in TATA POWER Safety manual.

Equipment requirements

Manual and powered hoisting units must be in compliance with all requirements of TATA POWER Standard for new hoisting equipment. The exceptions allowable for existing equipment are not allowable for hoisting equipment performing critical lifts.

If the powered and manual hoisting equipment does not meet all the requirements for new hoisting equipment (Tata Power Standard for Heavy Equipment Movement), then the live equipment which the hoisted load will be traveled over shall be protected with adequate dunnage to protect the live equipment against a dropped load.

One of the most important requirements for both powered and manual overhead hoisting equipment is a back up load brake to hold the load in case of failure of the primary brake. On manual hoists the ability of the hoist operator to stop and hold the load using the hand chain serves as the second back up braking means, if the primary brake were to fail.

Equipment inspection

All hoisting equipment including the rigging hardware must have a thorough visual and functional inspection by a competent person immediately before the critical lift.

In addition, prior to the critical lift, a competent person must ensure the periodic inspection is up to date and all discrepancies have been corrected. This inspection should comply with the periodic inspection procedures as indicated in the “Maintenance Inspection Procedures for Rigging and Hoisting Equipment “.

Critical lift plan

A written, dated and signed critical lift plan should be prepared by the lead designated person responsible and doing the work. The critical lift plan shall be reviewed and signed by all those directly involved in making the lift, and those potentially affected, including those required to secure the plant should a hoisted load fall and cause a process disruption. If the lifting plan is required to go beyond the end of the shift, the designated person responsible for the lift must coordinate with the new shift workers to make sure the conditions are understood and have not changed. If the conditions have changed, a new critical lift plan should be provided.

It is recommended that the “Overhead Hoisting Equipment Critical Lift Plan document be use to document the critical lift.

Operator qualifications

Floor operated cranes – Operators of floor operated top running and under hung cranes, shall have passed a practical operating examination, specific to the crane being operated.

Hoists – Operator must be familiar with all operating controls and be instructed in the operation(s) to be performed.

Procedures

All site, corporate, and plant procedures must be followed for the critical lift.

TPSMS/CSP/HEMS/005/FORM/001 Annexure-2

OVERHEAD CRANE PRE-OPERATIONAL CHECKLIST

Area / Location : **Date :**

CRANE NO.	CAPACITY	TYPE	LOCATION	SHIFT 1 2 3
OPERATORS NAME:	**INSTRUCTIONS: Check all items. Inspect and indicate as: Satisfactory – S, Unsatisfactory – U, or Not Applicable – NA**			

	1. WALK AROUND INSPECTION	S/U/ NA		2. MACHINERY INSPECTION	S/U/ NA
a	Foundations		a	Holding Brake *	
b	Access		b	Load Control Brake	
c	Secured Items		c	Covers Secured	
d	Walkways/Handrails		d	Upper Sheaves *	
e	Bridge, Drive Motor		e	Wire Rope *	
f	Bridge Brake *		f	Hooks: Cracks, Wear, Deformation Throat Opening, Latch Operation *	
g	Hydraulics		g	Fluid Leaks	
h	Couplers/Connection Rods		h	Batteries	
i	End Trucks *		i	Electric Motors	
j	Rail Sweeps		j	Electric Panels	
k	Windlocks/Chock/Stops		k	Runway/Bridge Conductors	
l	Housekeeping		l	Runway/Bridge Collectors	
			m	Electrical Guards	
			n	Festoon System	
			o	Warning Tags/Signs	
			p	Exposed Electrical Hazards	
			q	Trolley Stops *	

TPSMS/CSP/HEMS/005/FORM/001 Annexure-2

OVERHEAD CRANE PRE-OPERATIONAL CHECKLIST
Contd.

3. OPERATOR CAB INSPECTION		S/U/ NA	4. OPERATION INSPECTION		S/U/ NA
a	Housekeeping		a	Power Supply Relay *	
b	Warning Tags *		b	Manual Reset	
c	Cab Door(s)		c	Stop Button/Control *	
d	Fire Extinguisher		d	Pendant Buttons *	
e	Controls Identification		e	Upper Limit/Main *	
f	Electrical Enclosures		f	Upper Limit/Auxiliary *	
g	Pendant Strain Relief		g	Lower Limit/Main	
h	Visibility/Windows		h	Lower Limit/Auxiliary	
i	Safety Devices		i	Bridge Controls *	
j	Warning/Indicator Light		j	Bridge Brake *	
k	Alarms		k	Trolley Control *	
			l	Main Hook *	
			m	Auxiliary Hook *	
			n	Work Area	
			o	Runway Stops *	
			p	Travel Limit Relays *	

INSTRUCTIONS: Inspect all applicable items each shift of operation. Suspend all operations immediately when observing an unsatisfactory condition for asterisked (*) items. In addition, suspend operation when any unsafe condition is observed and immediately notify supervisor. Other conditions not affecting safety shall be noted under "Remarks" and reported to supervisor.

REMARKS:

Inspected By (Name & Signature) :

TPSMS/CSP/HEMS/005/FORM/002 Annexure-3

OVERHEAD CRANE PERIODIC INSPECTION REPORT -FORMAT

Area / Location : **Date :**

MECHANICAL ITEMS						
MAKE:		**CAPACITY:**		**LOCATION:**		
STATUS CODE:	**SR** – Should be Replaced **NR** – Needs Repair **R** – Repaired **SN** – See Notes **N/A** – Not Applicable					
ITEM	**OK**	**CODE**		**ITEM**	**OK**	**CODE**
Bridge				- Cam Followers/Guide*		
- Alignment				- Runway End-Stops		
- Girders (camber)				- Railway Sweeps/Safety Lugs		
- Rails				- Energy Absorbing Bumpers		
- Walks, Ladders, Railings				**Mono Rail**		
- Trucks to Girder Connection				- Girders		
- Trucks				- Girder Supports		
- Wheels, Driver*				- Sway Braces		
- Wheels, Idler*				**Misc.**		
- Wheels, Bearings*				- Clearances Overhead (3")		
- Axles & Coupling*				- Clearances Lateral (2")		
- Squaring Shaft				Rated Load Markings:		
- Squaring Shaft Bearings				- Each Side of Crane Bridge		
- Squaring Shaft Couplings				- Each Hoist/Load Block		
- Motor Coupling				**Trolley Drive**		
- Gear Reducer				- Wheels, Driver*		
- Gear Reducer Oil Seals				- Wheels, Idler*		
- Axle Pinion				- Wheels, Bearings*		
- Axle Gear				- Axles & Couplings		
- Runway Alignment				- Motor Couplings*		

TPSMS/CSP/HEMS/005/FORM/002 Annexure-3

OVERHEAD CRANE PERIODIC INSPECTION REPORT - FORMAT

Contd.

ITEM	OK	CODE		ITEM	OK	CODE
- Gear Reducer				- Drum Grooving		
- Gear Reducer Oil Seals				- Drum Shafts		
- Axle Pinion				- Motor Pinion		
- Axle Gear				- Motor Gear		
- Cam Followers/Guides*				- Intermediate Pinion		
- Energy Absorbing Bumpers				- Intermediate Gear		
- End Stops				- Drum Pinion		
Hoist (M – Main) (A – Auxiliary)				- Drum Gear		
- Hook				- Hoist Case Bearing		
- Hook Bearing				- Mechanical Load Brake*		
- Sheaves*				- Friction Disc*		
- Sheave Bearings*				- Pawl*		
- Equalizer Sheave*				- Pawl Shifter		
- Rope/Chain				- Ratchet or Band		
- Rope Anchors				- Motor Coupling*		
				- Hoist Case Coupling*		

Needs Immediate Action:
Notes:
Circle One: **PASS** **FAIL**

INSPECTOR: (Name) _____ SIGNATURE: _____ DATE: _____

Items with * to be inspected prior to use as part of the Pre-Operational check and lubricated as needed. All other items to be inspected and lubricated annually.

TPSMS/CSP/HEMS/005/FORM/003 Annexure-4

OVERHEAD CRANE PERIODIC INSPECTION REPORT - FORMAT

Area / Location : **Date :**

ELECTRICAL ITEMS						
MAKE:		**CAPACITY:**		**LOCATION:**		
STATUS CODE:	**SR** – Should be Replaced **NR** – Needs Repair **R** – Repaired **SN** – See Notes **N/A** – Not Applicable					
ITEM	**OK**	**CODE**		**ITEM**	**OK**	**CODE**
Brakes				- Trolley Motor Rings		
- M.H. Brake Shoes & Disc				- M.H. Motor Bearings		
- M.H. Brake Linings*				- M.H. Motor Brushes*		
- M.H. Brake Linkage				- M.H. Motor Rings		
- M.H. Brake Coil				**Misc.**		
- A.H. Brake Shoes & Discs						
- A.H. Brake Lining*						
- A.H. Brake Linkage						
- A.H. Brake Coil						
- Trolley Brake Shoes & Disc						
- Trolley Brake Lining*				**Controls**		
- Trolley Brake Linkage				*- For Magnetic Control*		
- Trolley Brake Coils				- Master Switches		
- Hydraulic Brake Bleeder*				- Push-button Station		
Motors				- M.H. Contactors		
- Bridge Motor Bearings				- A.H. Contactors		
- Bridge Motor Brushes*				- Trolley Contactors		
- Bridge Motor Rings				- Bridge Contactors		
- Trolley Motor Bearings				- M.H. Overhead Relays		
- Trolley Motor Brushes*				- A.H. Overhead Relays		

TPSMS/CSP/HEMS/005/FORM/003 Annexure-4

OVERHEAD CRANE PERIODIC INSPECTION REPORT - FORMAT

Contd.

ITEM	OK	CODE		ITEM	OK	CODE
Controls (continued)				**Resistors**		
- Trolley Overhead Relays				- M.H. Resistors		
- Bridge Overhead Relays				- A.H. Resistors		
- M.H. Limit Switch Contacts				- Trolley Resistors		
- A.H. Limit Switch Contacts				- Bridge Resistors		
For Manual Drum Control				**Mainline**		
- M.H. Finger Tips*				- Mainline Switch		
- M.H. Segments*				- Fuses (Sizes.....)		
- A.H. Finger Tips*				- Power Wiring		
- A.H. Segments*				- Control Wiring		
- Trolley Finger Tips*				- Trolley Collectors*		
- Trolley Segments*				- Runway Collectors*		
- Bridge Finger Tips*				- Bridge Conductors		
- Bridge Segments*				- Runway Conductors		

Needs Immediate Action:
Notes:
Circle One: **PASS** **FAIL**

Inspected By :(Name)_____ Signature:_____ Date :_____

Items with * to be inspected prior to use as part of the Pre-Operational check and lubricated as needed. All other items to be inspected and lubricated annually.

TATA POWER

Mobile Crane Safety Procedure

Rev No.	Reason for Revision	Prepared By	Checked By	Approval by
Rev 00	First release	R&P Sub Committee	D Kamath	Vijay Chourey
Rev 01	Standardization of procedure	Sambit Kumar Sahoo (Group Head (Mechanical) - Core Technology)	Navendra Singh (Group Head – P & CB; Corp Safety.)	Vijay Chourey (Chief – Corp Safety)

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1. **OBJECTIVE:**

Objective of this procedure is to provide minimum requirements for safe operation of mobile cranes and to establish mandatory requirements and practices to protect personnel & property from hazards associated with mobile crane related jobs.

2. **SCOPE:**

This procedure applies to all operating and project sites of Tata Power Group companies.

3. **EXPECTED RESULTS:**

3.1. Manage jobs related to Mobile Crane safely.

3.2. Control of incidents related to Mobile Crane operation.

3.3. Compliance to Regulatory requirements related to Mobile Crane & Lifting tools.

4. **ACCOUNTABILITY & RESPONSIBILITY:**

4.1. ACCOUNTABILITY: Concerned Division's Heads/Assets Custodian.

4.2. RESPONSIBILITY:

4.2.1. Lift Engineer/ Supervisor:

4.2.1.1. Shall check suitability of crane referring Load chart & raise the request in prescribed format including all details. Load Chart will be provided by the crane supplier / contractor (Refer Annexure -6 for load Chart).

4.2.1.2. Completion of mandatory requirements such as vehicle entry permit, Risk assessment.

4.2.1.3. Use tested lifting tool-tackles of appropriate capacity (sling / synthetic belt / D-shackle / tailing hook etc.)

4.2.1.4. Shall prepare Lifting plan for all critical lifts.

4.2.1.5. Ensure Area/ground preparation will be done wherever required. It will be done with consultation of SBU/Site - Civil Engineer if crane is required to position on soft soil.(For supporting crane outriggers sufficient wooden blocks/thick metal sheets will be placed on soft soil)

4.2.1.6. Ensure tool box talk of all movements & rigging operations.

4.2.1.7. He shall discuss rigging plan with rigger, signal man & crane operator for safe execution of job.

4.2.1.8. Ensure operating locations are far enough away from shoring, excavations, trenches, buried utilities, foundations, etc. to eliminate the risk of collapse.

4.2.2. Signalman & Riggers:

4.2.2.1. Shall follow procedure to use mobile crane, best rigging practice for safe operation of crane.

4.2.2.2. Shall use only lifting tools which are tested & of appropriate capacity.

4.2.2.3. Rigging foreman/signal man shall identify himself by wearing reflective jacket.

4.2.3. Crane Operators responsibilities:

4.2.3.1. Check ground condition & position the crane.

4.2.3.2. Crane Operator shall check all interlock & safety devices are in working condition. He will inform his supervisor & concern plant engineer if anyone is not in working condition. (i.e. Anti two blocking, Safe Load Indicator)

4.2.3.3. The operator must understand its functions and limitations as well as its particular operating characteristics.

4.2.3.4. Having a thorough knowledge of the information contained in the crane's operating manual.

4.2.3.5. Familiar with the crane's load chart (Refer Annexure -6 for load Chart). The operator must understand the correct meaning of all notes and warnings and be able to calculate or determine the crane's actual net capacity for every possible configuration of the machine.

4.2.3.6. Inspecting and maintaining the crane regularly as prescribed by both the owner and manufacturer.

4.2.3.7. Informing the owner of any problems, needed maintenance, or necessary repairs to the machine. This should be done in writing, preferably in the machine's logbook or inspection report.

4.2.3.8. Recording in the log or report the details of all inspections, maintenance, and other work done on the crane while in the field.

4.2.3.9. Supervising and training the apprentice if one is present.

4.2.3.10. Being aware of any site conditions that could affect the crane operation. Be particularly cautious around power lines. The operator must refuse to operate if the crane, hoist rope, or load will come closer to a power line than the absolute limit of approach specified in law.

4.2.3.11. Checking that the site is adequately prepared for the crane.

4.2.3.12. Reviewing the planned operation and requirements with the site supervision.

4.2.3.13. Finding out the load and rigging weight and determining where the load is to be placed. Although the operator is not responsible for determining the weight of the load, if the operator lifts it without checking the weight with site supervision, then the operator becomes fully responsible for the lift and any consequences that result.

4.2.3.14. Checking the load chart to ensure that the crane has sufficient net lifting capacity for every lift (Refer Annexure -6 for load Chart).

4.2.3.15. Selecting (from the range diagram) the best boom, jib, and crane configuration to suit the load, site and lift conditions.

4.2.3.16. Assembling, setting up and rigging the crane properly.

4.2.3.17. Following the manufacturer's operating instructions in accordance with the load chart.

4.2.3.18. Considering all factors that might reduce crane lift capacity and adjusting the load weight to suit. This will include such factors as weather conditions and ground conditions.

4.2.3.19. Knowing basics of rigging procedures and ensuring that they are applied (this is possible only when the load is visible to the operator).
4.2.3.20. Maintaining communication with signalman & riggers.
4.2.3.21. Operating mobile crane in a smooth, controlled, and safe manner.
4.2.3.22. Shutting down and securing the machine properly when it is unattended.
4.2.3.23. Exercising the right to refuse to operate the crane if there is cause to suspect the lift might be unsafe.
4.2.3.24. Holding Vehicle Fitness Certificate / copy of valid license / safety card document.
4.2.3.25. Equipment handing checklist should available with operator prior to lift if the load above two MT.
4.2.3.26. Conduct functional tests prior to using the equipment.
4.2.3.27. At the beginning of each operator's shift, the upper limit switch (anti-two-block) of each hoist shall be tried out under no load. Extreme care shall be exercised; the block protection shall be kept in line.
4.2.3.28. While any employee is touching the load or hook, there shall be no hoisting, lowering, or traveling.

5. GLOSSARY/ DEFINITIONS:

Attachment description - List type of slings; belts, wire ropes, chains, shackles etc. to be used to attach the load, if required make a simple sketch under lift description.

Anti-two-blocking device - a device that, when activated, disengages all crane functions whose movement can cause two-blocking.

Abnormal operating conditions—Environmental conditions that are unfavorable, Harmful, or detrimental to the operation of a mobile crane (e.g., excessively high or low ambient temperatures, exposure to weather, corrosive fumes, dust-laden or Moisture-laden atmospheres, and hazardous locations).

Approver: Location Manager in charge of plant/dept. Authorized shall be as per the permit to work procedure.

Competent person - one who is capable of identifying existing and predictable deficiencies in mobile cranes and boom trucks.

Critical lift—A lift using an Mobile crane where, because of the characteristics and properties or travel path of the load, a hoist failure or loss of control of the load could result in a serious personal injury, serious environmental incident, serious process safety incident, or significant disruption to operations. Critical Lift shall contain one or more of following criteria –

a. Tandem Lift (use of two or more cranes simultaneously)
b. Capacity utilization of crane exceeding over 85%.
c. lifting of man using crane boom
d. Travel path crossing over process plant/process pipelines
e. Cost of load exceeding one Million Rupees.

Capacity loading - It will be calculated by dividing the total weight with the safe workload at lift radius. It shall not exceed 85% of mobile crane. For capacity loading above 85% a lifting plan is required. No capacity loading above 100% shall be allowed, equal to 90% of load test. If Safe Load Indicator is not installed the capacity loading shall not exceed **60%;** if above a lifting plan is required. For lifting personnel the capacity loading must be below 50%.

Emergency operations - operations that include fire, power line contact, loss of stability, or control malfunction.

Eccentric Load - Load center of gravity does not correspond to the geometrical center, e.g. an unevenly loaded container. In case of eccentric load for heavy loads, say above 2 Tons, center of gravity should be calculated and lifting points defined accordingly. For light loads the most practical is to determine the center of gravity by trial and error without lifting the load completely off the ground.

Ground for crane set up safe - Can the ground support the point load from outriggers or crawlers? Ground loading capability must be established. Underground cables and pipes exposed to the load of the crane shall be identified and if required protected by spreading the load by e.g. applying spreaders under the outriggers. Experiences at site and elsewhere have shown that paved areas are not necessarily having the loading capability as per design.

Hazard Identification & Risk Assessment: Hazard Identification & Risk Assessment is to identify and evaluate the hazards, Risk and put controls measures for safe execution of activities.

Hazard: Source or situation with potential for harm, something that can cause body injury / occupational illness, damage company property.

HIRA: Hazard Identification and Risk Assessment

JSA: Job Safety Analysis

Job: A piece of physical work defined by time or other limits and that has a clear start and end point.

Job Safety Analysis: Job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job. In a JSA, for each basic step of the job, it is to identify potential hazards and to recommend the safest way to do the job.

LEL: Lower explosive limit

LOTO: Lock out Tag out

Load: Weight of load can be from equipment data sheet, marking on packing, marking on pipe spool, calculation (add 15% allowance for inaccuracies) or weighing. Guessing the weight of the load is not allowed. Crane user shall maintain record of how the weight was derived until the lift is successfully completed.

Length x Width x Height (LxWxH): Is required for bigger equipment for deciding lifting radius and lifting height. For bigger surface, say above 25 m2, also wind loads need to be considered. For small pipe spools, valves etc. this data is not required.

Lift Radius: Maximum horizontal distance between the point at which the center of crane rotation meets the ground and the vertical centerline passing through the load lifting attachment.

Lift Height: The height above the setting of the crane that the load must be lifted to. To derive at the boom height the length of hook, slings and load must be added as well as some free space above any equipment the load will be slew over.

Mobile Crane: A Crane that is self-propelled. This includes crawler cranes, wheel-mounted cranes, Hydra and any variations thereof. Overhead cranes, gantry cranes, side boom tractors, trolley boom cranes, and cranes with a rated capacity of one ton or less are specifically excluded and relevant Standard Operating Procedure (SOP) for the same may be followed.

Non Routine Job / Task: Where an SOP / SMP is not available or the conditions of the SOP / SMP have changed

PPE: Personal Protective Equipment

PTW: Permit to Work

Periodic Inspection: Detailed safety and maintenance inspection performed by a qualified person to verify compliance with the provisions of legal requirements.

Risk: The likelihood (probability) which can lead to potential negative consequences.

Risk Assessment: A systematic and structured process whereby hazards present in a workplace, or arising from workplace activity, are identified, risks assessed / evaluated, and decisions prioritized in order to reduce risks to acceptable levels.

Safe Access Route: To the place for the crane set up shall be checked with SS or SFE. Ensure that ground can carry the load of the crane. If soil is soaked with water the loading capability is significantly reduced. Check for underground cables and pipes as well as vicinity to any above ground obstructions like fire hydrants, firewater valves and pits. Ensure that trailer bringing the load also has a safe access, not blocked by the intended set up of the crane.

Safe Workload at lift radius: Will be derived from the selected Crane Load Chart for the calculated lift radius and boom length (Refer Annexure -6 for load Chart). Adjustment shall be done in relation to valid load test and only 85% of the load test value shall be considered as safe workload.

Shall: Mandatory requirement

Should: Optional requirement

Severity: The level of consequence / harm of an event that could occur due to exposure to the hazard present

SWL: Safe working load

SLI: Safe Load Indicator, it is a system which cut-off all the unsafe crane operations if overloaded and anti two blocking comply.

SHE: Safety, Health and Environment

Standard lift - If load to be lifted weighs less than 15 ton, it is a standard lift. The crane user is required to complete “Mobile Crane Planning & Risk Assessment Checklist”.

Two-blocking: The condition in which the lower load block or hook assembly comes in contact with the upper load block or boom point sheave assembly. (Condition under which the load block or load suspended from the hook becomes jammed against the crane structure preventing further winding up of the hoist drum)

Total weight - It is the sum of the weight of the load and weight of hook block, slings and attachment.

Task / Activity: A sequence of steps taken to conduct a job. A task is a sub element of a Job.

Weight of hook block, slings and attachments shall be derived from crane load chart and tables for slings (Refer Annexure -6 for load Chart).

6. PROCEDURES:

6.1. GENERAL PRECAUTIONS : Observe the following precautions when operating a mobile crane:

6.1.1 Do not leave a crane unattended even for a short time, unless all loads have been removed, lowered to the ground or the engine shut down and brakes applied.

6.1.2 Do not operate a crane beyond 35 KMPH wind speed that may put the load or personnel at risk. Always use the cranes load rating charts for guidance, these have wind and weather factors built into them.

6.1.3 Faulty slings shall be tagged for destruction with an “Out of Service” Tag and returned to store as scrap material.

6.1.4 Discard any wire rope used on a crane, when the visible number of broken wires in any length of rope diameter exceeds 5% of the total number of wires in the wire rope.

6.1.5 Check that there are no loose objects on a load that could fall during lifting.

6.1.6 All mobile cranes fitted with outriggers shall have the outriggers during lifting operation.

6.1.7 No slewing of these cranes is to take place unless outriggers are fully extended and in place.

6.1.8 Do not use the crane to drag the load along the ground, this may result in severe overloading.

6.1.9 The work area, equivalent to that of the extended jib, should be barricaded to ensure un-authorized personnel do not enter the area.

6.1.10 A signalman shall walk alongside a load using tag lines attached to the load, slung from a crane while the load is being transported form one area to another.

6.1.11 Use tag lines to prevent loads from turning or swaying while the crane is in motion of lifting a load.

6.1.12 Avoid sudden braking and fast hoisting, luffing and slewing.

6.1.13 Do not under any circumstances, use a crane to lift a load over personnel, or allow anyone to ride the load.

6.1.14 Keep personnel well clear of the suspended loads.

6.1.15 The crane shall only be operated minimum 6 M away from live electrical lines or away from safe arching zone whichever is higher.

6.2. PLANT AREA PRECAUTIONS:

6.2.1. Do not operate a crane over live process equipment. If such an operation is unavoidable, Risk Assessment shall be prepared with specific scope for working over live process equipment and the risk assessment will include a lift assessment from experienced crane supervisors/operators that operate the hired machines, a Work Permit must be obtained from the area responsible.

6.2.2. When cranes enter into plant areas there is always a chance of the crane being an ignition source and as such will be required to have all necessary permits and certification relating to access criteria as well as a gas test carried out were applicable.

6.2.3. Where people not involved in the lifting operation but could otherwise come into the area steps to prevent that from happening will be required, barriers shall be provided at ground and all levels to prevent this occurring. Appropriate warning signs shall be displayed on the barriers.

6.2.4. All communication devices shall be rated to prevent ignition sources, if working in a plant that has hazardous areas with an ignition risk.

6.3. PRECAUTIONS WHEN OPERATING NEAR LIVE ELECTRICAL LINES:

6.3.1. All electrical lines shall be treated as live unless the crane operator has received, from the electricity distributor or transmission line operator, documentary evidence that the conductors have been positively de-energized, isolated and earthed. Where such documentary evidence has been made available, it shall state the date and time frame of isolation and any special conditions and precautions.

6.3.2. The crane shall only be operated minimum 6 M away from live electrical lines or away from safe arching zone whichever is higher.

6.4. AERIAL CONDUCTOR (OVERHEAD POWERLINE) CONTACT PRECAUTIONS:

If the crane or load contacts live electrical line, concerned department/agency shall be immediately notified of the situation and, until assistance is received, a competent person shall remain in a prominent position to warn of the danger of electrocution.

In such an event the crane operator should act as follows:

6.4.1. Remain inside the cabin or on the crane.

6.4.2. Warn all other personnel to keep away from the crane and not to touch any part of the crane, rope or load.

6.4.3. Without anyone approaching the crane, operate the crane in such a manner to break contact, where possible.

6.4.4. When unable to move or disentangle the crane from the aerial conductors, remain inside the cabin or on the crane and take no further action until it is confirmed that conditions are safe.

6.4.5. When it is essential to leave the cabin or crane because of fire or some other reason then, to avoid being electrocuted, jump clear as far away from the crane as possible and avoid touching the crane and the ground at the same time. When moving away from the crane, shuffle or hop slowly across the affected area to avoid a simultaneous contact with areas of high potential difference

6.5. Inspection of Mobile Crane: There are three levels of crane inspections used at sites. These inspections are conducted by three categories of inspectors. In addition to the mandatory requirements and advisory guidance covered below. Sites should be aware that local regulations may impose additional mandatory inspection requirements beyond those listed in this standard.

6.5.1. Inspection Prior to use on sites (Internal) :

6.5.1.1. Mobile cranes shall be inspected by Operator prior to use on sites.

6.5.1.2. A checklist shall be used to document the inspection. (Annexure - 1)

6.5.1.3. The inspection shall cover the general condition of the crane and the availability of required safety equipment in accordance with manufacturer's recommendations and site requirements.

6.5.1.4. If a mobile crane is removed from a site and then returned, it shall be re-inspected before it is used again on the site.

6.5.2. Frequent Inspection (Internal: daily and monthly – Annexure- 1)

6.5.2.1. Mobile crane operators shall inspect all controls and safety devices including safe travel limit alarms & fill daily checklist before beginning of work in each shift.

6.5.2.2. Crane operator's inspection shall be documented and records maintained.

6.5.2.3. Crane operator shall inspect mobile cranes at least once in a month following the same inspection methodology used in the prior-to-use inspection as per Annexure - 1.

6.5.3. Periodic Inspection (External):

6.5.3.1. Mobile crane equipment shall receive periodic inspection by a competent person (third party) at least annually.

6.5.3.2. This competent person may be supplied by an independent agency.

6.5.3.3. For company-owned mobile cranes, the annual inspection records shall be available on site.

6.5.3.4. For equipment owned, leased, or rented by a contractor, the periodic inspection record shall be reviewed prior to use.

6.5.3.5. Cranes that remain on site and are idle for more than one month shall receive a prior-to-use inspection by Operator before being returned to service.

6.5.3.6. Cranes that are idle for more than six months shall receive a periodic inspection by a competent person before being returned to service.

6.6. Maintenance, Repairs and Modifications:

6.6.1. All maintenance and repairs shall be in accordance with manufacturer's Recommendations.

6.6.2. Preventive maintenance of crane shall be done as per manufacturer's Recommendations.

6.6.3. All minor repair requirement shall fulfilled at the earliest if found while daily check.

6.6.4. For all major repair/maintenance use detailed SOPs which are made based on manufacturer's Recommendations.

6.6.5. Modifications or major repair affecting capacity or safe operation shall have the manufacturer's written approval.

6.6.6. Records of maintenance, repairs, and modifications shall be maintained.

6.6.7. After major repairs/modification the crane shall be thoroughly examined and tested to its maximum capacity and re-certified by competent person.

6.7. Rope Safety & Replacement:

6.7.1. Rope must be secured to drum.

6.7.2. No less than three wraps of rope shall remain on the drum when the hook is in its extreme low position.

6.7.3. Rope end shall be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer.

6.7.4. Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope.

6.7.5. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendation or relevant Indian standard.

6.7.6. Clips shall be drop-forged steel in all sizes manufactured commercially. When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be retightened

6.7.7. Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working condition requirements with test certificate.

6.8. Crane Operations

6.8.1. General Safety Instructions:

6.8.1.1. During hoisting, sudden acceleration or deceleration of the moving load shall not to be permitted.

6.8.1.2. When hoisting, make sure the load does not come in contact with any obstructions primarily electrical. While operating the crane, it should be ensured that the high tension power line is dead/ safe working distance maintained as per voltage level.

6.8.1.3. Cranes should not be used for side pulls. Only freely suspended load may be side pulled.

6.8.1.4. At all times the operator must avoid carrying loads over people. Positive barricading with display board shall be provided around the crane & unauthorized entry shall be restricted inside barricading.

6.8.1.5. The load must not be lowered below the point where less than three full wraps of rope remain on the hoisting drum.

6.8.1.6. Make sure hook have safety latch. The load is well balanced. Avoid tip loading, and loading on hook latch.

6.8.1.7. Never lift the load over the rated capacity (refer load chart only to decide Safe Working Load)

6.8.1.8. Do not operate with kinked, twisted or damaged rope

6.8.1.9. Never leave the suspended load unattended. If it is required because of any failure, high wind condition or specific requirement by plant, additional support under all four outriggers shall be applied. Support below the suspended load also to be provided if possible.

6.8.1.10. Holding brakes on hoists shall be applied automatically when power is removed

6.8.1.11. A drag brake (a brake which provides retarding force without external control) may be applied to hold the trolley in a desired position on the bridge and to eliminate creep with the power off

6.8.1.12. If a load is supported by more than one part of rope, the tension in the parts shall be equalized.

6.8.1.13. Hooks shall meet the manufacturer's recommendations and shall not be over loaded. Hook testing shall be carried out every year with annual inspection of crane.

6.8.1.14. Sufficient barricading around crane shall be made to protect people working near mobile crane before slewing operation check clearance for counter weight.

6.8.1.15. Crane operator should strictly follow the instructions/signals given by site supervisor on job.

6.8.1.16. Special permission to be obtained from site in-charge after considering following guidelines for travelling with suspended load

- Load may need to be secured during travel
- Swing lock and/or other interlocks may need to be engaged
- Consider routes of travel and ground conditions
- Additional signalperson assistance needed
- Speed limit restriction shall be mentioned in Job Safety Analysis (JSA)

6.8.2. Stability function of load charts:

6.8.2.1. Dynamic factors caused by the crane motion and the load (e.g. for boom movement, application of brakes, swaying of the load) and wind effects on the load and boom.

6.8.2.2. Mobile cranes requires that the stability factor of mobile cranes shall be based on 75% of tipping for stationary mode, and 66.6% for pick-and-carry mode.

6.8.2.3. Strong winds impose additional loads on a crane and affect the crane's stability. Maximum permissible wind speed of 36 km/hour shall be for mobile crane operation.

6.8.3. Ground conditions and crane support

6.8.3.1. Where the ground is compact the distance of any part of the crane support timbers from the excavation should be at least equal to the depth of the excavation (1:1 rule).For example, for a three meter deep trench in compact ground, the outrigger timbers or pads should be a horizontal distance of at least three meters away from the closest edge of the trench wall.

6.8.3.2. Where the ground is loose or backfilled the distance of any part of the crane support timbers from the excavation should be at least twice the depth of the excavation (2:1 rule). For example, for a three meter deep trench in backfilled ground, the outrigger timbers or pads should be a horizontal distance of at least six meters away from the closest face of the trench wall.

6.8.4. Timbers pads under outriggers of crane:

6.8.4.1. Size of timber pads required under outriggers should be chosen as per sample example calculation mentioned Annexure –2.

6.8.5. Loading capacity of crane

6.8.5.1. **Capacity loading** will be calculated by dividing the total weight with the safe workload at lift radius. It shall not exceed 85%. For capacity loading above 85% a lifting plan is required. No capacity loading above 100% shall be allowed, equal to 90% of load test.

6.8.5.2. If Safe Load Indicator is not installed the capacity loading shall not exceed 60%; if above a lifting plan is required.

6.8.5.3. Lifting of personnel shall not be allowed using mobile crane.

6.8.6. Multi Crane Lift Considerations (Safety measures for multiple crane lifts):

6.8.6.1. Lifting a load with two or more cranes requires greater attention to planning and supervision, because the effects of the relative motion between the cranes may create additional loadings on the cranes, the load and the lifting gear in place. Where possible, avoid hoisting a load with more than one crane. However, where it is necessary to lift a load using more than one crane, the following steps should be taken:

6.8.6.1.1. A person certificated to work as an intermediate rigger should be in overall control of the lift.

6.8.6.1.2. Make an accurate assessment of:

a. The share of the load which is to be carried by each crane;
b. How the load sharing is to be proportioned; and
c. How the proportioning is to be maintained.

6.8.6.2. Lifting plan shall be made by Lift engineer/Supervisor for critical lifts. The following factors are to be considered when planning for critical lifts:

a. Mass of the load;
b. Position of the center of gravity;
c. Mass of the lifting gear;
d. Safe working capacity of the lifting gear; and
e. Synchronization of crane motions.

6.8.6.2.1. Make sure the instructions to each crane operator and other persons involved are clear, and rehearse the operation wherever possible.

6.8.6.2.2. Use cranes of equal capacity and similar characteristics, where practicable.

6.8.6.2.3. Make sure that both cranes are aligned in the same direction when using non slewing type cranes in the pick-and-carry mode.

6.8.6.2.4. Tandem lifts are not to be undertaken unless all cranes are fitted with a load indicator. Where multiple hoisting operations are carried out, the following minimum capacity requirements for each crane will apply:

(i) For two (2) cranes—20% greater than the calculated share of the load;
(ii) For three (3) cranes—33% greater than the calculated share of the load;
(iii) For four (4) or more cranes—50% greater than the calculated share of the load.

6.8.6.3. If it is not possible to comply with the minimum capacity requirements stated above, then the Lifting engineer must check and certify the lifting plan.

6.8.7. Rigging Safety Tips:

a. Determine the weight of the load. Do not guess.
b. Determine the proper size for certified slings and components.
c. Do not use manila rope for rigging
d. Do not use slings, eye bolts, shackles, or hooks that have been cut, welded, or brazed.
e. Use two guy ropes (one on top & two at the bottom) to avoid swing during lift.
f. Determine the center of gravity and balance the load before moving it
g. Initially lift the load only a few inches to test the rigging and balance
h. Loads should be well secured.
i. Slings should be adequate to the task. Slings should be un-kinked and load balanced and secured.
j. No sudden stops.
k. No loose items on load or crane before lift.
l. Bumping into runway stops is prohibited.
m. Rigger should have knowledge of rigging plan, slings & belt fixing methods.
n. Hoist line must be vertical prior to the lift (remove slack in the hoist slowly).

6.8.8. Handling the Load:

6.8.8.1. **Size of load** - The crane shall not be loaded beyond its rated load except for test purposes as provided in the Rated Load Test section.

6.8.8.1.1. All routes which pass through overhead pipe rack, cable trays etc. should be marked with clear vertical height (headroom). This clear vertical height should be considered in planning stage of movement of oversize load and heavy equipment etc. (refer annexure-5).

6.8.8.1.2. In case of oversize load, it shall be ensured that overall walkway/route from where load shall move/pass is greater than the size of load and lifting equipment considering its width and height (WXH).

6.8.8.2. **Attaching the load**

a. The hoist chain or hoist rope shall be free from kinks or twists and shall not be wrapped around the load.
b. The load shall be attached to the load block hook by means of slings or other approved devices
c. Care shall be taken to make certain that the sling clears all obstacles
d. Care shall be taken to ensure that hook lock is in healthy condition & also the slings resting on hook to be tied by a rope to prevent the slings from coming out of the hook.

6.8.8.3. **Moving the load**:

a. The load shall be well secured and properly balanced in the slings on lifting device before it is lifted more than a few inches
b. Before starting to hoist, the following conditions shall be noted:
c. Hoist rope shall not be kinked
d. Multiple part lines shall not be twisted around each other
e. The hook shall be brought over the load in such a manner as to prevent swinging

6.8.8.4. **Care During hoisting:**

a. There is no sudden acceleration or deceleration of the moving load
b. The load does not contact any obstructions.
c. While any employee is touching the load or hook, there shall be no hoisting, lowering, or traveling.
d. Operators shall avoid carrying loads over people.
e. The operator shall test the brakes each time a load is approaching the rated load handled. The brakes shall be tested by raising the load a few inches and applying the brakes
f. The load shall not be lowered below the point where less than two full wraps of rope remain on the hoisting drum.
g. The supervisor shall ensure that the operator does not leave his position at the controls while the load is suspended.

h. when the load or hook approaches near or over persons, the warning signal should be sounded
i. Control excess swing by providing guy ropes (one on top & two at the bottom) from opposite side of load.
j. The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control

6.8.8.5. **Common Hazards Associated with Mobile Crane:** Assessment of hazards shall be made before movement & use of mobile crane. Examples of hazards to be considered include the following:

a. Electrocution, principally due to proximity of crane boom to overhead/ nearby power lines & underground cables.
b. Ground condition, soft soil, nearby trench etc.
c. The presence and activity of other people and equipment in the vicinity of the work.
d. Toppling of crane, caused by instability or overloading
e. Being struck by swinging, lifting, lowering or falling load. (Due to failure of slings, D-shackles, crane rope, other lifting tool-tackles or mechanical/hydraulic system of crane.)
f. Low illumination
g. Wrong signaling
h. Noise
i. Smoke.
j. Heavy wind.

7. Records:

7.1. Daily/Periodic Mobile Crane Check list (TPSMS/CSP/MCS/006/FORM/001) –Retention – 12 Months

7.2. Annual Checklist/Form filled by competent person as per Factory Act – retention – three years.

8. Training & Communication:

8.1. Training of this procedure shall be covered as per Safety Training need identified across divisions.

8.2. Initial Communication to be done through Corporate Communication, Email and subsequently shall be made available at safety portal at Sangam.

9. VERIFICATION

9.1. Verification of implementation shall be done during Mobile crane procedure audit, field safety visit and site inspections.

10. Exceptions: Any Exception to this procedure shall only be done as per Document Control .Procedure (TPSMS/GSP/DC/014).

11. REFERENCES

- Indian Factory Act 1948 and State Factory Rules
- Permit-To-Work Procedure
- Job Safety Analysis (JSA) Procedure

- Hazard Identification & Risk Assessment (HIRA) Procedure
- Heavy Equipment Movement Safety Procedure

12. **Review:** Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in Incident investigation reports may be inputs for the review and revision of the procedure.

13. **ATTACHMENTS/APPENDIX :**

Refer Sample formats as Annexures attached in next page of this document:

Annexure 1: Daily/Periodic Mobile Crane Check list (TPSMS/CSP/MCS/006/FORM/001)
Annexure 2: Timber pads required under Outriggers- Examples
Annexure 3: Checks & Maintenance for Crane rope & hook
Annexure 4: Mobile Crane Planning & Risk Assessment guidelines
Annexure 5: Signage for Height Restriction (Example Illustration)
Annexure 6: Load chart for Mobile Crane -90 Ton, Boom length 11-50 M (Typical)

TPSMS/CSP/MCS/006/FORM/001 **Annexure-1**

Mobile Crane Daily Check List

Operator:			**Company:**		
Crane type:			**Model:**		
Location:			**Unit no.:**		
Date:			**Shift:**		
1 – Pre Start-up Walk-around	**Status OK**	**NO**	**3 – Start-up**	**Status OK**	**NO**
Cab – glass/doors/2nd exit	□	□	Instrumentation – warning	□	□
Steps/ladder – secure/clean	□	□	Oil pressure	□	□
Wheels & tires – rims/lug nuts/tire condition/ inflation	□	□	Air (brake) pressure	□	□
Boom – angle indicator/jib/condition	□	□	Coolant temperature	□	□
Main/auxiliary hoist(s) – hook/attachment/block/sheaves/wire rope	□	□	Battery charge rate/level	□	□
Hydraulics – cylinders/hosing/pins/fittings/fluid level	□	□	Fuel level	□	□
Turntable – ring & pinion condition	□	□	Noises – engine sounds normal	□	□
Engine – fluids/belts/hoses/leaks/debris	□	□	Lights	□	□
Battery/batteries – secure/electrolyte level/ connections clean & tight	□	□	Horn	□	□
Counterweight – secure/condition	□	□	Accessories – wipers/heater/fan/radio	□	□
Drum(s) – condition/line spooled properly	□	□	LMI – functions/calibrated properly	□	□
Air (brake) tanks – condition/water drained/ petcock closed	□	□	House lock-pin – disengaged (as applicable)	□	□
Outriggers/stabilizers – condition/leaks	□	□	Other:		
Lights/strobes – condition	□	□			
Warning decals – in place/ condition/ legible	□	□			
2 – Interior Cab Checks	**Status OK**	**NO**	**4 - Function Checks**	**Status OK**	**NO**
Housekeeping	□	□	Boom – lift/lower/extend/retract	□	□
Fire extinguisher	□	□	Hoist(s) – raise/lower	□	□
Manufacturer's operating manual	□	□	Turntable swing	□	□
Log book	□	□	Outriggers/stabilizers	□	□
Inspection Certificate	□	□	Steering	□	□
External Certification	□	□	Transmission – gear & direction	□	□
Load charts/range diagrams	□	□	Brakes	□	□
Level indicator	□	□	Other:	□	□
Seat belt	□	□		□	□
Comments					
Operator Name & Sign:					

Annexure - 2

Timber pads required under Outriggers- Examples

Sample Example 1 – for a 40 MT crane

A mobile crane is to be set up on its outriggers on asphalt or dry clay/sand. The crane has a total mass of 32 tonnes and is to lift a 21.65-tonne load—21.65 tonnes is the maximum the crane can lift in the stability range of the load chart at 6 mtr radius. The lift plan requires the load to be slewed above each outrigger foot. Calculate the minimum required area of the timbers to be placed under each outrigger when lifting directly above an outrigger foot.
Lifted load (L) = 21.65 tonnes
Total crane mass (CM) = 32 tonnes
Maximum allowable ground pressure (PMAX) for Asphalt/dry sand/clay = 20 tonnes per m2
area = 0.65 x (CM + L) / PMAX
area = 0.65 x (32 tonnes + 21.65 tonnes) / 20 tonnes per m2
area = 22.75 tonnes / 20 tonnes per m2
area = 1.74 m2
Dimensions of outrigger timbers: √1.74 m2 = 1.32 m
Therefore, length x width of timbers required = 1320 mm x 1320 mm.

Sample Example 2 - for 30 Mt crane

A mobile crane is to be set up on its outriggers on asphalt or dry clay/sand. The crane has a total mass of 29 tonnes and is to lift a 15-tonne load—15 tonnes is the maximum the crane can lift in the stability range of the load chart at 6 mtr radius. The lift plan requires the load to be slewed above each outrigger foot. Calculate the minimum required area of the timbers to be placed under each outrigger when lifting directly above an outrigger foot.
Lifted load (L) = 15 tonnes
Total crane mass (CM) = 29 tonnes
Maximum allowable ground pressure (PMAX)) for Asphalt/dry sand/clay = 20 tonnes per m2
area = 0.65 x (CM + L) / PMAX
area = 0.65 x (29 tonnes + 15 tonnes) / 20 tonnes per m2
area = 22.75 tonnes / 20 tonnes per m2
area = 1.43 m2
Dimensions of outrigger timbers: √1.43 m2 = 1.2 m
Therefore, length x width of timbers required = 1200 mm x 1200 mm.

Sample Example 3 - for 125 Mt crane AMK-125

A mobile crane is to be set up on its outriggers on asphalt or dry clay/sand. The crane has a total mass of 86 tonnes and is to lift a 68-tonne load - 68 tonnes is the maximum the crane can lift in the stability range of the load chart at 6 mtr radius. The lift plan requires the load to be

slewed above each outrigger foot. Calculate the minimum required area of the timbers to be placed under each outrigger when lifting directly above an outrigger foot.
Lifted load (L) = 86 tonnes
Total crane mass (CM) = 68 tonnes
Maximum allowable ground pressure (PMAX)) for Asphalt/dry sand/clay = 20 tonnes per m2
area = 0.65 x (CM + L) / PMAX
area = 0.65 x (86 tonnes + 68 tonnes) / 20 tonnes per m2
area = 100 tonnes / 20 tonnes per m2
area = 5.00 m2
Dimensions of outrigger timbers: √5.00 m2 = 2.23 m
Therefore, length x width of timbers required = 2230 mm x 2230 mm.

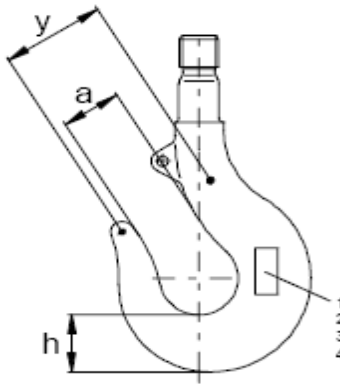
Maximum permissible ground pressure is shown for reference in below table.

Ground type	Maximum permissible ground pressure, P_{MAX} (Tonnes per m²)
Hard rock	200
Shale rock and sandstone	80
Compacted gravel (with up to 20% sand)	40
Asphalt	20
Compacted sand	20
Stiff clay (dry)	20
Soft clay (dry)	10
Loose sand	10
Wet clay	Less than 10

Annexure - 3

Checks & Maintenance for Crane rope & hook

Checks and Maintenance: Crane ropes, rope pulleys, load hooks and rope end fittings



Load hook sizes

Load hooks can be identified by the designation LAH .... on the type plate or by the designation RSN .... or RFN .... on the hook itself.

all dimensions in mm

Load hook	Hook no.	a	h	y	Threads
Lah 010 ...	RSN 08	38	37	-	M 24
Lah 020 ...	RSN 1.6	45	48	-	M 30
Lah 030 ...	RSN 2.5	50	58	-	M 36
Lah 050 ...	RSN 4	56	67	-	M 42
Lah 063 ...	RSN 5	63	75	-	M 45
Lah 080 ...	RSN 6	71	85	115	Rd 50 ◊ 6
Lah 100 ...	RSN 8	80	95	125	Rd 56 ◊ 6
Lah 125 ...	RFN 10	90	106	175	Rd 64 ◊ 8
Lah 160 ...	RFN 12	100	118	200	Rd 72 ◊ 8
Lah 200 ...	RFN 16	112	132	220	Rd 80 ◊ 10
Lah 250 ...	RFN 20	125	150	240	Rd 90 ◊ 10
Lah 320 ...	RFN 25	140	170	250	Rd 100 ◊ 12
Lah 400 ...	RFN 32	160	190	320	Rd 110 ◊ 12
Lah 500 ...	RFN 40	180	212	350	Rd 125 ◊ 14
Lah 630 ...	RFN 50	200	236	400	Rd 140 ◊ 16
Lah 800 ...	RFN 80	224	265	400	Rd 160 ◊ 18

Dimension "y" may differ from the value specified in the table (forging tolerance). Either the value in the table or a different value is engraved in the hook shank.

Monitoring and checking: Load hook

What to check:

Deformation

Load hooks according to DIN 15 401 and 15 402 up to load hook no. 5:

Hook opening and deformation, **dimensions "y" and "a" + max. 10%**

If the opening has widened by more than 10% of the maximum permissible limit, replace the load hook !

Surface fissures

If deformations are apparent: **Check surface for fissures** using an appropriate method **- or - replace the load hook !**

Damage and surface fissures may be removed notch-less, provided that the permissible tolerance levels are not exceeded.

If it is not possible to check the installed load hook, dismantle it !
Before making checks, ensure that the surfaces are put into a condition permitting the definite identification of surface fissures !

Wear

Wear on single or twin-hooks **may not be greater than 5% of the height "h"** according to DIN 15 401 and DIN 15 402.

It is **not permitted** to carry out welding work on load hooks, e.g. to compensate for wear !

Annexure - 3

Checks and Maintenance: Crane ropes, rope pulleys, load hooks and rope end fittings

Figure 1

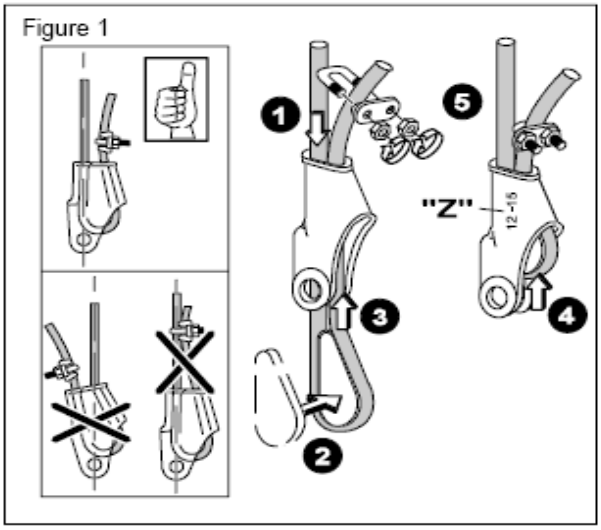
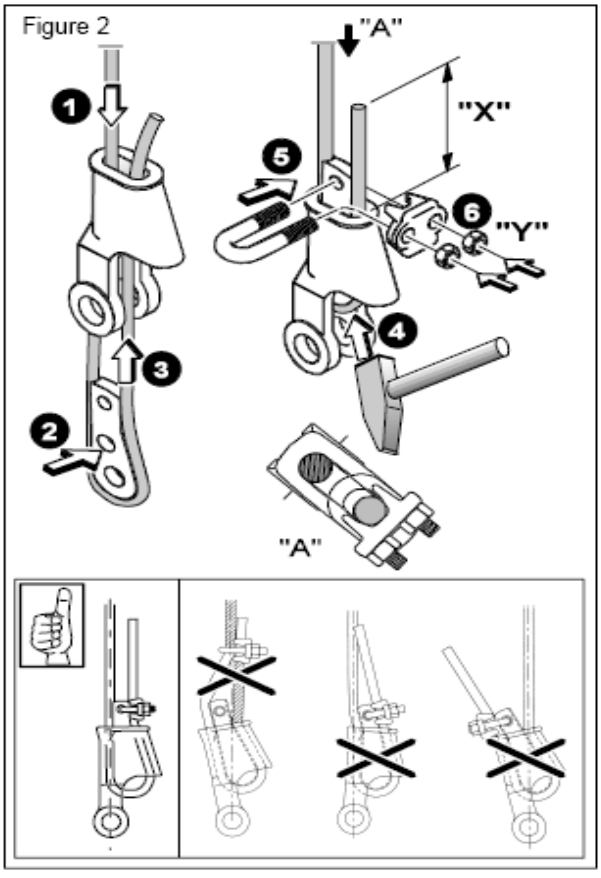


Figure 2



Installation, inspection and maintenance of wedge sockets !

Page 1 of 2

If the wedge socket is not properly installed:

- **Loads / crane parts may fall down. A falling load can seriously injure or kill.**
- **Do not side load the wedge socket.**

Maintenance and Inspection:

Always inspect the wedge socket, the wedge and the pin before using.

Do not use parts showing cracks.

Do not use modified or substitute parts.

Repair minor nicks or gouges to socket or pin by lightly grinding until surfaces are smooth. Do not reduce the original dimensions by more than 10% !
Damage must not be repaired by welding.

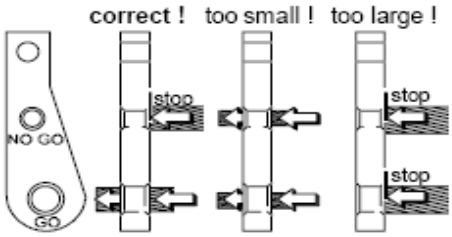
Inspect permanent connections once a year, or more often in severe operating conditions.

Installation:

See figures 1 and 2 for the installation process. These instructions must be followed.

The permissible rope diameter can be seen on the wedge socket body (**"Z"**). **Alternatively** it can be determined by the holes in the wedge.

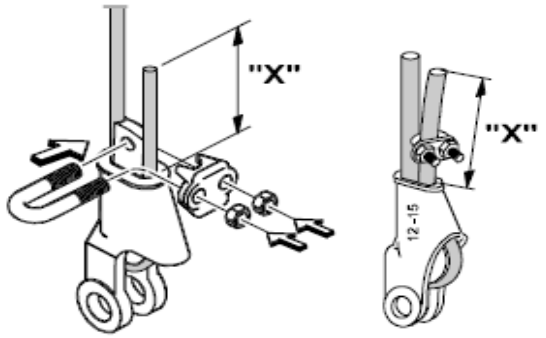
Example: The rope diameter for the following wedge socket size is:



Annexure - 3

Checks and Maintenance: Crane ropes, rope pulleys, load hooks and rope end fittings

Figure 3



Installation, inspection and maintenance of wedge sockets !

Page 2 of 2

Tail length of the dead end: "X"

Standard 6 to 8 strand wire ropes:
minimum of 6 rope diameters,
but not less than 150 mm

Rotation resistant wire ropes:
minimum of 20 rope diameters,
but not less than 150 mm
Ensure that the dead end is welded.

Annexure – 4

Mobile Crane Planning & Risk Assessment Guidelines

These checks should be done for each new set up even if the same crane is deployed in different set ups.

- **Does lift radius and boom length check with the planned**: With the crane set up measure the lift radius and check the boom length required. For hydraulic cranes the boom length can be read on the SLI and the lift radius measured checked against the SLI reading for lift radius. For crawler cranes boom length is fixed and can be taken from the load chart using the relevant configuration. If lift radius or/and boom length is bigger than planned, the capacity loading must be recalculated to check that the loading still is within prescribed limit; 85% for cranes with SLI, 60% for cranes without SLI or for crane used for lifting personnel.
- **Are outriggers fully extended, placed on load spreaders and crane leveled:** Check that all 4 outriggers are fully extended to the marking on each of the outriggers. **It is not allowed to proceed with the lift if any of the outriggers cannot fully be extended.** If possible always use the spreaders provided with the crane under the outriggers. Is the crane leveled as per spirit level installed in the crane? If the crane will move free on wheels (hydras) or on crawler with the load suspended ensure it will stay leveled.
- **Are out riggers set on solid ground free from water logging/soaking and on safe distance from any excavation, storm-water channel, pit, trench etc.:** Do not allow the crane setting on ground with water logging or soil soaked with water as the ground loading capability might be much lower than expected. The distance of any outrigger to an excavation, storm-water channel, pit (not RCC pit), trench must at least be equal to the depth of the cavity. Outriggers should not be placed above storm-water culverts without spreading the load.
- **crane boom:** When crane boom, fully extended, is pointed towards the overhead line the distance must be at least 6 meters away from the line. If required the line must be made dead and permit given by authorized electrical person.
- **Is crane slewing/movement free from any obstruction with at least 0.6 m:** Check that the crane can slew with the prescribed safety margin of 0.6 m, if not possible barricade the area to stop personnel access.
- **Is the crane free of any oil leakage:** When walking around the crane check for any oil leakage from the hydraulic system especially on the outriggers.
- **Is weather condition safe for lift:** High wind speed will have a significant impact on loads with high wind areas, say above 25 m^2. The wind might cause the lift line to get out of plumb and cause the crane to topple. If wind speed is above **35 km/hr** or 19.4 knots the lift shall be stopped. For lift of personnel the wind speed limit is 14 knots**.** Call MFS, ext. 11191, to get actual wind speed. Do not permit the lift if visibility is limited by e.g.heavy rain or fog. Avoid lift during not daylight hours**.** Do not lift during thunderstorm.

Annexure – 4

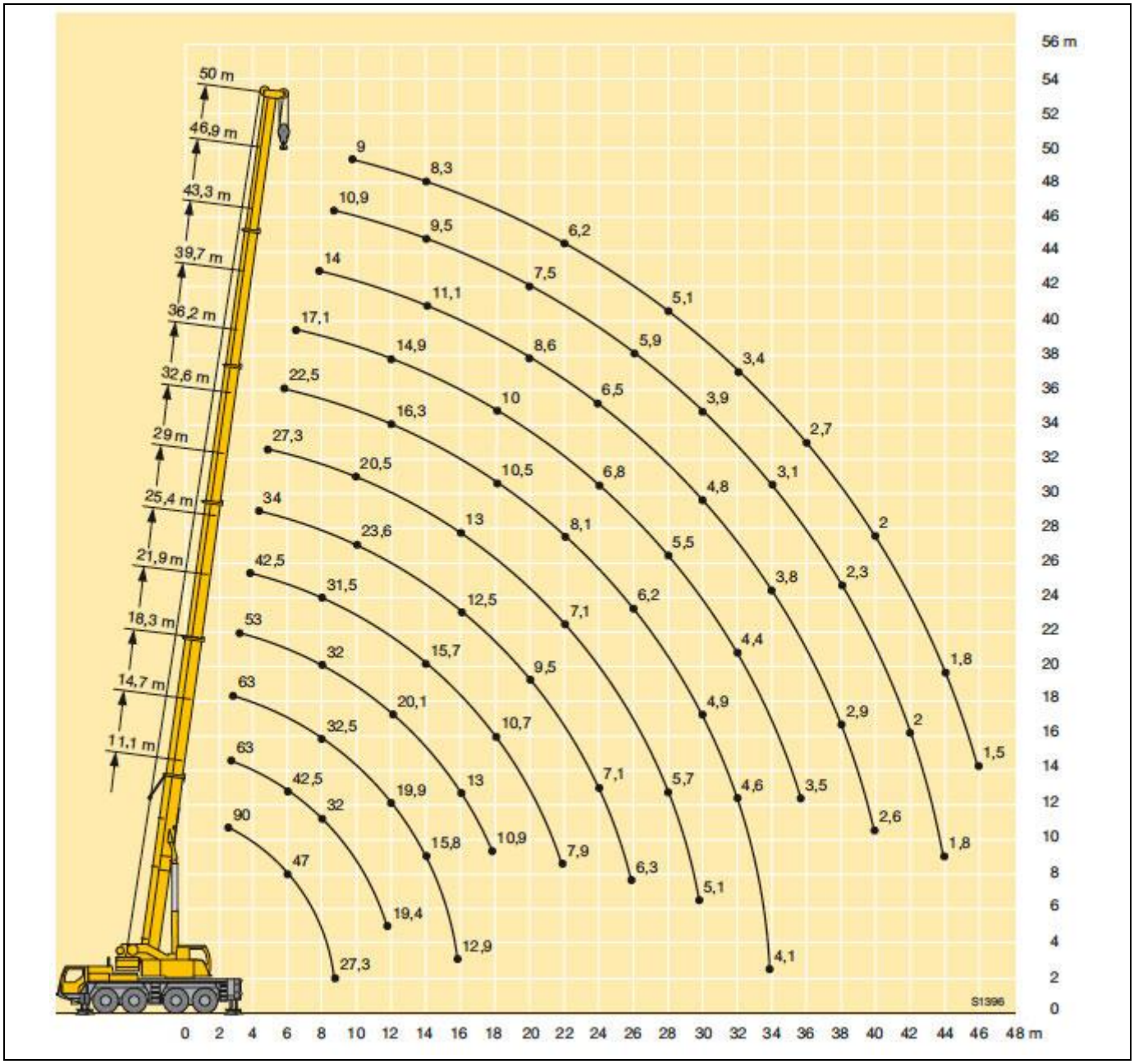
- **Are slings marked with safe load, valid color-coding and without any visual damage. Is capacity loading below 50%:** All slings, belts, shackles shall be visual inspected for wear and tear, cuts before any lift. **No damage shall be accepted.** The load on slings/belts shackles should not exceed 50% of the marked safe load. When lifting plan available higher sling loading is acceptable. Account for sling angles when more than one sling is used. A sling angle of 60 degree towards the load will increase the load in the sling with 15%, 45 degree with 41% and 30 degree with 100%. Slings used for lifting personnel shall only be loaded to 20%.
- **Are slings protected from sharp edges on the load:** A couple of incidences at site have happened when sharp edges have cut through the belts and caused the load to drop. Ensure that the slings are protected by e.g. fitting wooden beams between load and slings.
- **Is angle between sling and load more than 60 degree:** A small angle will cause high load on the sling and load, see above. If possible keep the angle above 60 degree and the extra load will be limited to 15%.
- **Are shackles used if more than 2 slings are attached to the hook:** To avoid undue load on the slings from each other, the slings shall be connected to the hook by help of shackles if more than 2 slings are used.
- **Is the load free from adhesion:** Ensure that the load is free from adhesion by e.g. use of a jack. If it is not possible to conclude that the load is free, e.g. during dismantling operation, add 100% to the load and check capacity loading.
- **Are lifting lugs free from visual defects:** Visual inspect lifting lugs for any defects.
- **Is load center of gravity known:** For eccentric load with unknown center of gravity always determine center of gravity by trial and error without lifting the load completely off the ground.
- **Is lift line plumb:** It is not allowed to use the crane for dragging the load as this could cause the crane to topple. The lift line shall hang vertical free from any obstruction above the center of gravity of the load.
- **Is the lift area free from any other conflicting activities:** During the lift other activities in the direct vicinity and especially under the load must temporarily be stopped. A crane operation is a hot job and no draining of hydrocarbon shall be allowed in the vicinity as long as the crane engine is running.
- **Is signaler in high visibility vest:** Ensure that the person signaling to the crane operator is in high visibility vest.
- **Is lift area barricaded? Are the slinger and signaler clear of the lifted load by use of guide ropes:** This is the ultimate precaution for all lifts. No person shall be allowed under suspended load. If it is not practical to barricade the area other means to keep people away must be used.

Annexure- 5

Signage for Height and Width Restriction (Example Illustration)

Annexure- 6

Load chart for Mobile Crane -90 Ton, Boom length 11-50 M (Typical)



Permit-To-Work (PTW) Procedure

Rev No.	Reason for Revision	Prepared By	Checked By	Approval by
Rev 00	First Release	-	-	-
Rev 01	Standardization of Procedure	Sunil Bartakke (Head-Biogas & Lavasa Project)	Navendra Singh (Group Head – P & CB; Corp Safety.)	Vijay Chourey (Chief – Corp Safety)
Rev 02	Alignment With SAP's Permit-To-Work (PTW)Management Process	Sudhir Kumar (Corporate Safety)	Navendra Singh (Head – Operation Safety; Corp Safety.)	Vijay Chourey (Chief – Corp Safety)

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1. OBJECTIVE:

To provide a standardized & uniform procedure for obtaining authorization to perform jobs require special consideration to ensure the safety of personnel, and protection of facilities by using a safe system of work and clear understanding between the working agencies / departments involved.

2. SCOPE:

This procedure applies to all operating and project sites of Tata Power Group companies.

3. EXPECTED RESULTS:

3.1. Manage jobs being done under Permit-To-Work (PTW) safely.

3.2. Control of incidents in Jobs related to Permit-To-Work (PTW).

3.3. Compliance to Regulatory requirements related to Permit-To-Work.

4. ACCOUNTABILITY & RESPONSIBILITY:

4.1 ACCOUNTABILITY: Concerned Division's Heads / SBU Heads / Assets Custodian.

4.2 RESPONSIBILITY: Working department, Contractors.

4.2.1 SBU Head / Assets Custodian:

- Implement and manage the PTW system and provide necessary resources of expertise in its application.
- Implement, apply, monitor and audit the Permit-To-Work System within the respective area.
- Delegate various levels of authority in accordance with needs, subject to appropriate training and competency.
- Oversee training programs for Permit Acceptors, Permit Issuers, Permit Approvers, Area Operators and Gas Testers as applicable.
- Ensure that those who are appointed as Permit Acceptors, Permit Issuers, Approvers and Area Operators are certified and competent to undertake the role.
- Ensure updated list persons certified and competent for PTW are available. Preferably list to be displayed at conspicuous location.
- Ensure regular audit of PTW process as a whole.
- Receive feedback from the users of the PTW system.

4.2.2 Permit Creator / Initiator / Applicant / Acceptor

The permit creator / initiator / acceptor / Applicant is a person who initiate the PTW and after its approval he accept it for performing the job. He / She shall be responsible for executing the entire job in full compliance with the PTW requirements. His/her responsibilities include the following:

- Understand the potential hazards involve in the job.
- Ensuring that LOTO is performed at all points as applicable before the commencement of the job.
- Understand how the hazards are controlled.
- Know the emergency situations likely to occur in the job / area and actions to be taken including evacuation procedure.
- Ensure that the Permit Holder understands all the hazards and controls, explaining them to the workers, and ensure that the controls are maintained throughout the execution of job.
- Inform all people who may be directly / indirectly affected by the job.
- Know the status of the job at all times, till its completion.
- Transfer duties formally as and when required.
- Know how to mitigate a possible incident, safe closure of job at such time, rescue of men and material, arrange / administer medical aid if required.
- Knowledge of first aid and its administration.
- Is aware of the on-site emergency plan.
- Lead and take care of his group at times of emergencies.

Permit Creator / Initiator / Applicant / Acceptor is typically maintenance engineer or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

4.2.3 Permit Issuer / Issuing Authority (Control Room Engineer)

The Permit Issuer shall be responsible for review the information provided and amend if required.

The Permit Issuer shall be responsible for the following:

- Confirm that all hazards associated with the job have been identified, assessed, managed and all relevant parties have provided their inputs and agree with the precautions.
- Ensure that the PTW contains scope of the job and the documented controls mentioned are adequate to ensure that the job can be completed safely.
- Ensure that all necessary supporting PTWs / Certificates / Checklist / JSA / drawings are attached or referred to in the PTW.
- Ensure that the Permit Acceptor knows the exact location and scope of the job, all the hazards that may be present and all the precautions and controls that must be taken and maintained during execution of the job.
- Confirm that all operational preparations, including process clearance and isolations, de-energizing and de-pressurizing have been completed.
- Lock out and Tag out (LOTO) shall be performed as per Tata Power LOTO procedure (TPSMS/CSP/LOTO/001) and isolation shall be done as per Standard Operating Procedure.
- Confirm that the job site is safe for the job to proceed.
- Specify on the PTW any additional precautions that need to be taken during the job.

- Identify any conflicts between the proposed job and other jobs in the area, and if necessary, cross-reference necessary controls in all such PTWs.
- Inform all persons who may be affected by the job.
- Know the status of the job at all times till it's completion,
- Ensure shift handover includes all ongoing or suspended PTWs with the upcoming Permit issuer.

Permit Issuer / Issuing Authority is typically Control Room Engineer or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

4.2.4 Permit Approver: Shift Incharge shall be a Permit Approver. The Permit Approver shall be responsible for ensuring that the hazards have been evaluated, adequate controls are provided and precautions are specified in the PTW. He/she is responsible for the following:

- Know the hazards including potential hazards and confirming that all hazards associated with the job have been identified, assessed and managed and all relevant agencies / Departments have provided their inputs and agreed with the precautions.
- Know how to control and manage hazards involve in the job.
- Verify that the job area is safe to commence and carryout job, including checking that representative atmospheric sampling results are within the acceptable limits.
- Ensure that the PTW contains scope of the job and the documented controls mentioned are adequate to ensure that the job can be completed safely.
- Ensure that all necessary supporting PTWs / Certificates / Checklist / JSA / drawings are attached or referred to in the PTW.
- Confirm that the Permit Holder has been explained the exact location of the job, all the hazards & risks that may be present and all the precautions and controls are taken care of.
- Confirm that all operational preparations, including process clearance, isolations, de-energizing and de-pressuring etc. have been completed.
- Approve the PTW.

Permit Approver is typically Shift In- Charge or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

4.2.5 Permit Holder - Person who is supervising the working party at the site and executing the job.

The Permit Holder shall be responsible for commencing and completing the authorized job while fully complying with all the requirements as mentioned in PTW. His / Her responsibilities include the following:

- Know and understand the potential hazards involved in the job.
- Know and understand how the hazards are controlled.
- Know the right kind of PPEs required, ensure correct use and compliance thereof.

- Know the emergency situations likely to occur in the job / area and actions to be taken including evacuating the area.
- Deliver the Tool-Box-Talk (TBT) to the workers involved prior to commence the job and record the same.

4.2.5 Individuals working within the PTW system should ensure that:

- Received and understood safety instructions during TBT on the particular job and they understand the hazards and the precautions taken or to be taken.
- Shall not start any job without valid PTW and TBT.
- In case of stop work, the site and any equipment they are using is left in a safe condition
- If in any doubt or if circumstances change, they must stop work and consult with their supervisor / Permit holder.

5 GLOSSARY/ DEFINITIONS:

PTW - Permit-To- Work

Permit-To-Work (PTW) system: A PTW system is a formal written system used to control and execute certain types of jobs safely, which are identified as potentially hazardous. It is also a means of communication between different departments, plant supervisors, operators, agencies etc.

Permit Creator / Initiator / Applicant / Acceptor: The Permit Creator / Initiator / Acceptor / Applicant is a person who initiate the PTW and after its approval he accept it for performing the job. He / She shall be responsible for executing the entire job in full compliance with the PTW requirements. Permit Creator / Initiator / Applicant / Acceptor is typically maintenance engineer or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

Permit Issuer / Issuing Authority (Control room engineer): The Permit Issuer shall be responsible for review the information provided and amend if required. Permit Issuer / Issuing Authority is typically Control Room Engineer or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

Permit Approver: Shift Incharge shall be a Permit Approver. The Permit Approver shall be responsible for ensuring that the hazards have been evaluated, adequate controls are provided and precautions are specified in the PTW. Permit Approver is typically Shift In- Charge or equivalent, however terminology of this designation may vary based upon hierarchy/ organization chart.

Permit Holder: Person who is supervising the working party at the site and executing the job. The Permit Holder shall be responsible for commencing and completing the authorized job while fully complying with all the requirements as mentioned in PTW.

Job Safety Analysis: Job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job. In a

JSA, for each basic step of the job, it is to identify potential hazards and to recommend the safest way to do the job.

6 PROCEDURES:

6.1 Applicability:

Valid Permit-To-Work (PTW) and approve Job Safety Analysis (JSA) shall be taken for all jobs other than approved exception list. Exception list shall be prepared at each division and shall be approved by division chief.

The Plant / installation which is completely under the supervision / custody of External party / contractor; as a principle employer, company has to ensure the PTW system must be in place. Such PTW system those are from external party / contractors shall be approved by concerned division chief.

6.2 Preparation

6.2.1 Co-ordination: It is important to ensure that job requiring PTW, shall be planned and coordinated in order to avoid risks caused by simultaneous activities.

6.2.2 Planning : Careful planning of job requiring a PTW shall take place to ensure:

- Appropriate approval for the job.
- All persons in charge of areas which may be affected are made aware and hence take precautions against possible interaction with other work activity
- Sufficient time to identify all potential hazards, implement precautions and prepare the worksite. One suggested technique of achieving this is a Job Safety Analysis.

6.2.3 Job safety Analysis (JSA): Job safety Analysis (JSA) shall be done directly into the system or alternatively it can be done externally and uploaded in the system.

6.2.4 Types of Permit-To-Work (PTW): The types of work for which PTW systems shall be applied include maintenance and repair, inspection, testing, construction, dismantling, modification and cleaning.

The types of Permit-To-Work (PTW) as per SAP-EHS include:

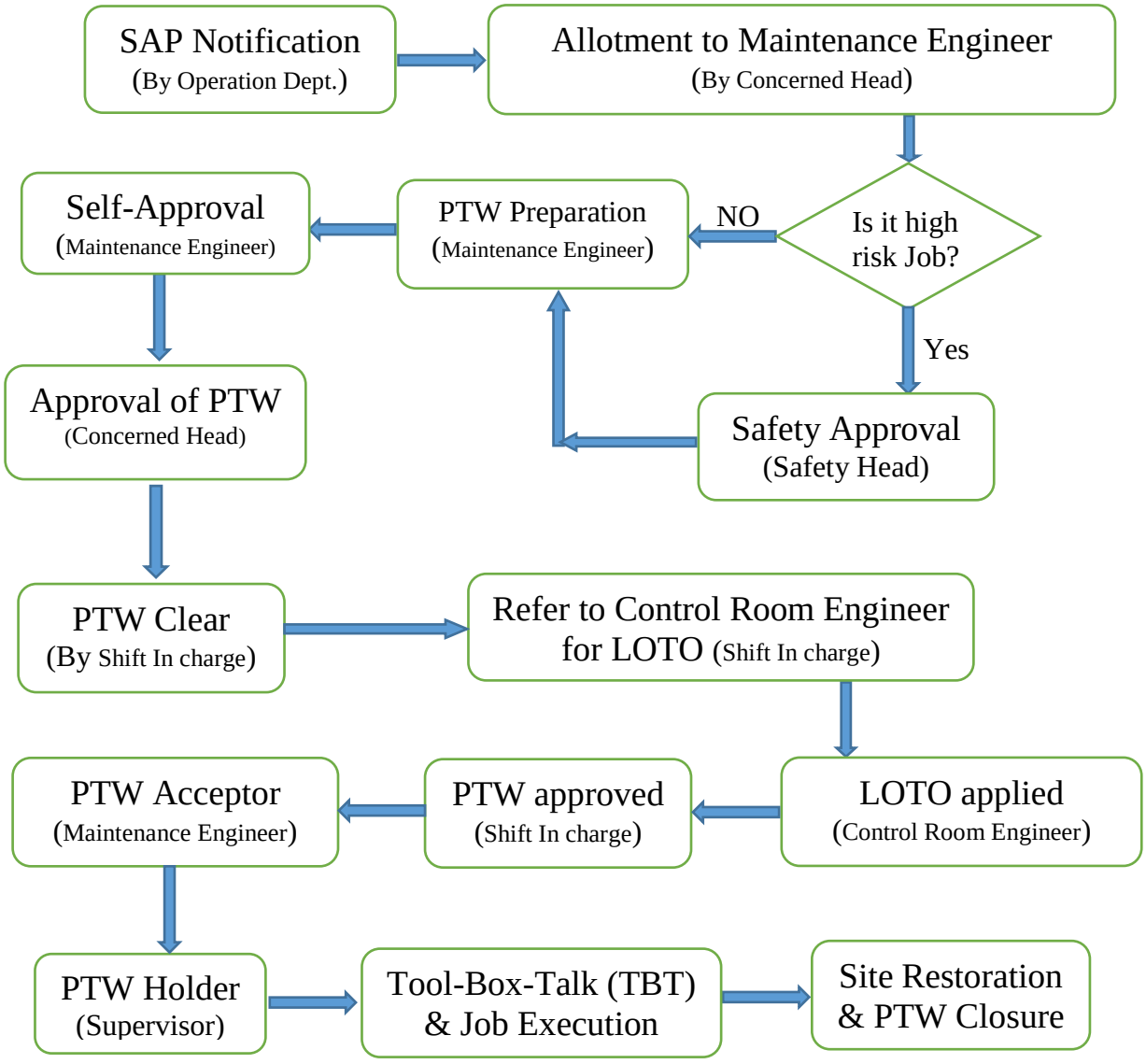
- General Permit
- Confined Space Entry Permit
- Electrical Permit
- Excavation Permit
- Hot Permit
- Lifting and slinging Permit
- Project Nature Permit
- Radiography Permit
- Working at Height Permit

6.2.5 Cross Reference: The objective of cross reference is to ensure that no interaction takes place between work activities which might endanger the safety of personnel or the installation. The PTW issuer shall, by knowledge of work going on in his area of responsibility, be aware of potential interaction when issuing multiple PTWs for the same piece of equipment or system, or where there may be potential conflict with adjacent work activities.

Such situations should be minimized by careful planning and suitable precautions which should include an appropriate method of cross referencing the different tasks.

It may be that the interacting activities are covered by separate PTW issuers, in such cases close co-ordination shall be necessary.

6.2.6: Process Flow of Permit-To-Work (PTW) in SAP:



For all high risk jobs and Project nature Job, it is mandatory to take approval to safety while processing the PTW.

If the job is high risk in nature then concerned Head has to change the status to High Risk Job (HRJB) while assigning the Notification to Person responsible. Only concerned Head is authorized to set the User Status LRJB & HRJB.

Permit initiator while preparing permits can still change job as high risk even if Concern head has marked it as low risk.

If the Notification Status is “High Risk Job”, system will not allow to delete the concerned Head & Safety Approvals in all types of PTW. If User tries to delete the Approvals, System will show error message.

Concerned Safety Advisor shall check the adequacy of control measures defined in PTW and JSA for all such high risk jobs. He may further recommend additional control measures before grant of approval. At PTW clearing stage s/he is responsible to give their inputs in JSA & PTW and during this s/he may not visit site, however subsequently during site visit s/he shall check deployment of control measures.

Line management is wholly responsible for the implementation of JSA & PTW at site which has been cleared by safety. Tool box talk (TBT) shall be done prior to start of each job and to be recorded as per Annexure -6 {Tool-Box-Talk (TBT) TPSMS/CSP/PTW/008/FORM/ 002}.
PTW shall be displayed at site or alternatively it should be made available at site. Permit Holder shall remain present at site during entire period of job.

6.2.7 Extension of Permit-To-Work (PTW): In order that effective control is maintained in changing circumstances there shall be a limit on the life of a permit. Depending on the job, extension of all PTW other Project Nature Permit shall be up to 7 days. Maximum extension in case of project nature permit may be upto 30 days. It shall be necessary to intimate about the extension of PTW to all concerns involved. All concerns shall maintain all existing controls measures in place as mentioned in PTW & JSA.

6.2.8 Tagging: An essential ingredient of any safe system of work is the method and integrity of the isolation procedure. The isolation principle to be adapted, prior to carry out maintenance or repair, will be determined by a number of factors e.g. potential for pressure, dangerous substances, lack of oxygen, moving machinery etc. It is beyond the scope of this document to provided guidance on the isolation required for each potential hazards, please refer Standard operating procedure of each equipments and Tata Power LOTO procedure - TPSMS/CSP/LOTO/001. In case isolations are required,

the Issuing Authority will maintain the required isolations. Electrical team will be involved in this step if electrical isolations are required.

The following additional points should be considered within the isolation procedures:

- Complex isolations should be planned and recorded on a working drawing. This should be discussed between the Permit Issuer and Permit Acceptor to ensure all isolation points are clearly understood and agreed. The marked up drawing should be readily available to all concerned. Consideration should be given to attaching a copy to the PTW.
- It is essential that the isolation standard is commensurate with the type of job being carried out, plant operating conditions and other local influences.
- Isolation procedures should include all energy sources, i.e. mechanical, electrical, hydraulic pressure etc.
- The tag or key number should be recorded on the PTW form or on a separate form which should in turn be cross referenced and attached to the PTW form.
- isolation should only be applied and removed on instruction from the person issuing the PTW
- If more than one task is to be carried out on part of a plant or piece of equipment, there is a risk that on completion of one of the tasks the isolations are removed and the equipment is put back into service. Controls should be in place to prevent premature de-isolation where dual tasks are involved
- if the work is not able to be completed within the shift the site should be checked by both the Permit Acceptor and the Permit Issuer to ensure it is left in a safe condition and equipment cannot be reinstated until all job shall be properly completed
- If the PTW is suspended, the status of the job site should be left on display in a suitable location e.g. Control Room, and the isolation padlock keys kept in a secure place to ensure no unauthorized access.

All persons authorized to carry out isolations should be assessed for their competence prior to appointment i.e. they should

- Be suitably qualified
- Have experience on the plant/equipment
- Have received specific instructions on the plant, methods of isolation etc.
- Be able to demonstrate their knowledge by examination.

Their areas of responsibility shall be made quite clear.

6.2.9 Gas Testing: PTW preparation may involve a consideration of the likely presence of flammable or toxic gases, or oxygen deficiency/enrichment, at the worksite.

Where such a consideration is necessary then gas testing shall be undertaken.

Persons involved in gas testing shall be adequately trained in the use of gas testing equipment, and in the interpretation of results.

The responsibility of what to test for, where to take samples, and the minimum number of samples to take should lie with the Permit Issuer. Gas testing shall be done as close to the commencement of work as possible.

Results of any gas testing shall be recorded and timed, as per Tata Power confined space entry procedure (TPSMS/CSP/CSE/003- Annexure 05/form No TPSMS/CSP/CSE/003/FORM/003). In case ambient parameters changes beyond acceptable levels during the work, the PTW shall be suspended.

6.2.10 Signatures: Once PTW approved, auto generated mail shall go to Permit Initiator to execute the job as requested in PTW. Signature of Permit Holder and respective field operation engineer (area / equipment owner) shall be taken on initial issue of PTW and thereafter for revalidation on each day/shift as applicable.

6.3 Process

6.3.1 Display of Permit-To-Work (PTW): It is important that permits shall be displayed so the persons who need to be aware of them, or to refer to them, are able to do so.

Copies should normally be distributed/displayed as follows:

- At the worksite. Where this is not practicable (e.g. at an exposed location), the Permit Acceptor of the job should retain the copy, having ensured that the working party members are familiar with its content and control measures.
- At the main control / co-ordination room, where these should be displayed in a systematic arrangement.

6.3.2 Revalidation: Permit-To-Work (PTW) should be revalidated in order that the Permit Issuer can satisfy himself that the conditions under which the PTW was originally issued remain unchanged to allow work to continue.

Revalidation shall be done on next day before start of the same job as per Annexure 5 Permit-To-Work (PTW) Revalidation (TPSMS/CSP/PTW/008/FORM/001). It can be revalidated upto 7 days only except project nature permit. For project nature permit revalidation may be done upto 30 days. The maximum validity of the permits is defined and revalidation beyond this period are not allowed. In such cases, the PTW is closed and a new PTW shall be issued.

6.3.3 Suspension: In the event of any of the following circumstances occurring during the course of an activity under permit, the Permit Holder must refer back to the Permit Issuer (through Permit Acceptor) on the appropriate course of action:

- The specified equipment or tools to be used not being available.
- Any changes in the type and nature of work.
- Occurrence of any condition / situation during the progress of the work that was not anticipated.
- Any change in the process condition or the surrounding. (E.g. unexpected release of gas from a nearby tank).
- An emergency in the area.
- Any change in the weather condition.

6.3.4 Shift Hand-overs: Shift changeovers can be one of the most vulnerable times for the PTW system. The failure to pass on information or the correct information has been shown to be the cause of many accidents. There is sufficient overlap to allow proper review and discussion of the status of all Permit-To-Work.

Written means of communicating information can be by:

- PTW Log Book
- PTW Files
- Display Boards
- Computer Screen/Print Out

Or a combination of any of the above. Whichever arrangements are adopted, the shift handover arrangement shall be monitored regularly to ensure its continued effectiveness.

6.3.5 Action in an Emergency / break down situation: During emergencies, when working party is not able to generate notification, PM order and hence PTW; in such situation control room will use WCT6 and WCT7 to create safety tag number for the outage. However, maintenance engineer will have to generate - notification, PM order, PTW subsequently and attach safety tag (by using WCLE & WCD transaction) number. No safety norms to be violated and standard SOP to be followed. For more details please refer "SAP – PM Training Manuals (Use of WCT6 & WCT7 - Guidelines Emergency Outages) available at Sangam web page at following path -

Saarthi > Project Saarthi > Training > Module > Plant Maintenance (PM) > 2. PM Processes - Others> 06. Creating Safety Tags (WCT6 & WCT&) without PTW-Emergency Outages.

6.3.6 Monitoring: The monitoring of the PTW shall be during entire span of job execution by Permit Holder.

6.3.7 Trial Required After Maintenance Work: If trial of equipment is required to be taken after the maintenance work is completed, the temporary un-tagging cycle is initiated. (Refer Tata Power LOTO procedure (TPSMS/CSP/LOTO/001 Rev 01) 6.5 Temporary Removal of Lockout/Tag out Devices)

Process is initiated by authorized person by activating the button “Untag temporarily” in the work clearance document, and system status is updated as BTUG - Untag temporarily. (Annexure-1 Permit- To-Work (PTW) - Status Sequence)

Tags are removed from the field and system is restored to original condition. After the tags are removed and the system condition is restored the authorized person activates a button in the work clearance document “Temporarily untagged” and the system status is up-dated as ETUG – Temporarily Untagged.

Trial is taken for the system and after successful completion of the trial, the authorized person activates the button “Tagged” in the Work Clearance document and system status is updated as ETG – Tagged.

If trial is unsuccessful then Maintenance team (Permit Initiator) have two options based on the scenario.

If work can be done to rectify the problem, then the isolations of the field equipments will be done again using the temporary untagging cycle as explained above. Temporary untagging cycle will be repeated using the same tags and field equipments will be isolated. Work will be executed in the equipment and further trial will be taken.

However, if work cannot be executed again and a scope change in work is required then the PTW shall be closed. Untagging of the field equipments will be done and work clearance document shall be closed. Scope change in work shall be handled by creating a sub order through Work Order Management and new PTW will be created.

6.4 Completion

6.4.1 Work Completion: When the maintenance work is completed then maintenance person indicates in the work order system that work is completed by activating Work Completed Button on order header and the System Status is updated to WOCO – Work completed.

Order operations are confirmed and order is updated with a system status as CNF – Confirmed.

6.4.2 Closing of Permit-To-Work (PTW): After the Work is completed the Permit-To-Work (PTW) is surrendered and the PTW is closed and the System Status is updated as CLSD – Closed.

The system provides a facility to automatically set CLSD status on the Permit-To-Work (PTW) when Maintenance order gets WOCO status.

6.4.3 Un-Tagging Process: After the Permit-To-Work (PTW) is surrendered then un-tagging process is initiated by activating the button "Untag" in the Work clearance document and the System status is up-dated as BUG – Untag.

System is restored to original condition as per the un-tagging conditions in the Work Clearance document and tags are removed from the field equipment and with proper housekeeping of job site.
Authorized person will activate the button "Untagged" in the Work Clearance Document and the system status is updated as EUG – Untagged.

6.4.4 Closing the work Clearance Documents: After untagging of the isolation the Work Clearance Document is closed and the system status is updated as CLSD – Closed.

6.4.5 Closing of Maintenance Order: After the PTW is closed, the order is technically completed and the system status is set to TECO – Technically Completed. The order cost is then settled by the finance section to the respective cost center and order is business completed and system status is up-dated as CLSD - Completed.

6.4.6 Housekeeping: Housekeeping shall be ensured before the start of job as well as after the completion / cancellation of job. Permit-To-Work (PTW) shall be closed only after restoration of housekeeping of the Job site.

7 Records:

Filled Permit-To-Work (PTW) – Retention Period - One year
Filled Permit-To-Work (PTW) Revalidation (TPSMS/CSP/PTW/008/FORM/001) -– Retention Period - One year
Record of Tool-Box-Talk (TBT) TPSMS/CSP/PTW/008/FORM/ 002} – Retention Period - One year

8 TRAINING & COMMUNICATION

8.1 Training of Permit-To-Work procedure shall be carried out to cover for following-

(i) Permit Issuer,

(ii) Permit acceptor,

(iii) Permit Holder,

(iv) Permit approver.

List of trained and competent person in PTW as a Permit Issuer, acceptor, holder & approval shall be displayed at conspicuous location.

8.2 Initial Communication to be done through Corporate Communication, Email and subsequently shall be made available at safety portal at Sangam

9 VERIFICATION

Verification of implementation shall be done during Permit-To-Work (PTW) procedure audit, field safety visit and site inspections.

10 EXCEPTION: Any Exception to this procedure shall only be done as per Document Control .Procedure (TPSMS/GSP/DC/014).

11 REFERENCES

- EPM 04.01.02 - Safe Working Procedures
- Indian Factory Act 1948 and State Factory Rules (As amended)
- SAP PM Work Permit Management Process - PM_Work_Permit_Management_04
- Excavation Safety (Shoring and Sloping) Procedure - TPSMS/CSP/EXS/002
- Tata Power LOTO Procedure - TPSMS/CSP/LOTO/001
- Tata Power Job Safety Analysis (JSA) Procedure - TPSMS/CSP/JSA/009
- Tata Power Hazard Identification & Risk Assessment (HIRA) Procedure - TPSMS/GSP/HIRA/005
- Tata Power Confined Space Entry Procedure - TPSMS/CSP/CSE/003
- Tata Power Work At Height Procedure - TPSMS/CSP/WAH/004

12 REVIEW: Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in Incident investigation reports may be inputs for the review and revision of the procedure.

13 ANNEXURES:

Annexure-1: Permit- To-Work (PTW) - Status Sequence

Annexure-2: Sheet 1 - Permit -To-Work (PTW) Issuance Process

Sheet 2 - Permit-To-Work (PTW) Return Process

Annexure - 3: SAP Permit-To-Work (PTW) Process Flow (Tabular Form)

Annexure -4: SAP Standard Report

Annexure-5: Permit-To-Work (PTW) Revalidation (TPSMS/CSP/PTW/008/FORM/001)

Annexure-6: Tool-Box-Talk (TBT) TPSMS/CSP/PTW/008/FORM/ 002}

Annexure -1

Permit- To-Work (PTW) - Status Sequence

During the process of the isolations, execution and completion of work, the system status of Header and Item level gets up-dated based on the processing phase. The processing phase could be as follows –

- Tagging Phase
- Un-tagging phase
- Temporary Un-tagging Phase

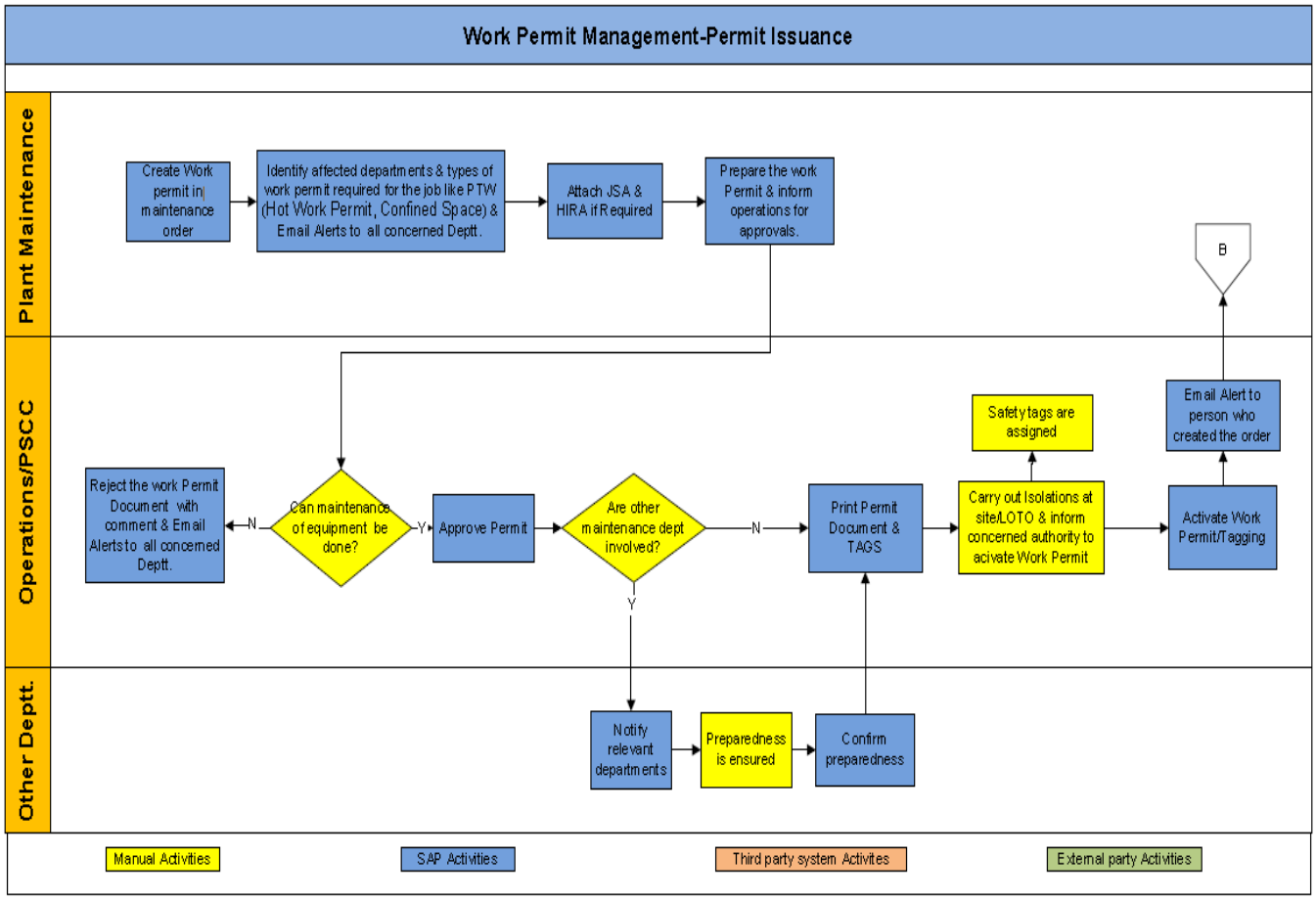
System Status	Description	Remarks
CRTE	Created	When the Work Clearance Document is created the system status is set to CRTE – Created.
PREP	Prepared	After review of the Work Clearance Document Header and Item data the WCD system status is set to PREP – Prepared. This will allow for the approval and Tagging process.
CHNG	Change	WCD status PREP is revoked.
CLSD	Closed	After the items are untagged the WCD status is set to CLSD – Closed and the WCD is completed in the system.
ITG	Initial Tagging Condition	WCD items system status is set to ITG – Initial Tagging Condition when the WCD is set to Prepared condition. The items cannot be deleted from the WCD document after ITG status is set to the items.
PROC	Processing	When the Tagging process is initiated System status is set to Processing.
BTG	Begin Tagging	WCD items system status is set to BTG- Begin Tagging status when tagging process is initiated by activating the “TAG” button.
PTAG	Print Tag	WCD items status is set to “PTAG” status when tag printing button is activated for printing the Tags from the system
ETG	End of Tagging	WCD items system status is set to “ETG” - Tagged status when “Tagged” button is activated after the items are physically isolated and tags are placed on the isolated items.
INAC	Inactivated	WCD item status is set to INAC- Inactivated status if WCD item is not relevant and items already have system status ITG.

BTUG	Begin Temporary Untagging	WCD items status is set to “BTUG” status when “Untag Temporarily” button is activated for Trial purposes.
ETUG	End of Temporary Tagging	WCD items status is set to “ETUG” status when “Temporarily Untagged” button is activated after conditions are restored for trial purposes.
TEST	TEST Cycle	Permit trial cycle in progress
PTST	Print Test Tag	WCD items get “PTST” status when tag printing button is activated for printing the Tags from the system for test cycle.
UNT	Untaggable	WCD items get UNT – Untaggable status to indicate items can be untagged.
BUG	Begin Untagging	WCD items get “BUG” untag status when “Untag” button is activated to begin Untagging Process
EUG	End of Untagging	WCD items are set to “ETG” Untagged status when “Untagged” button is activated.

Annexure-2

Sheet 1

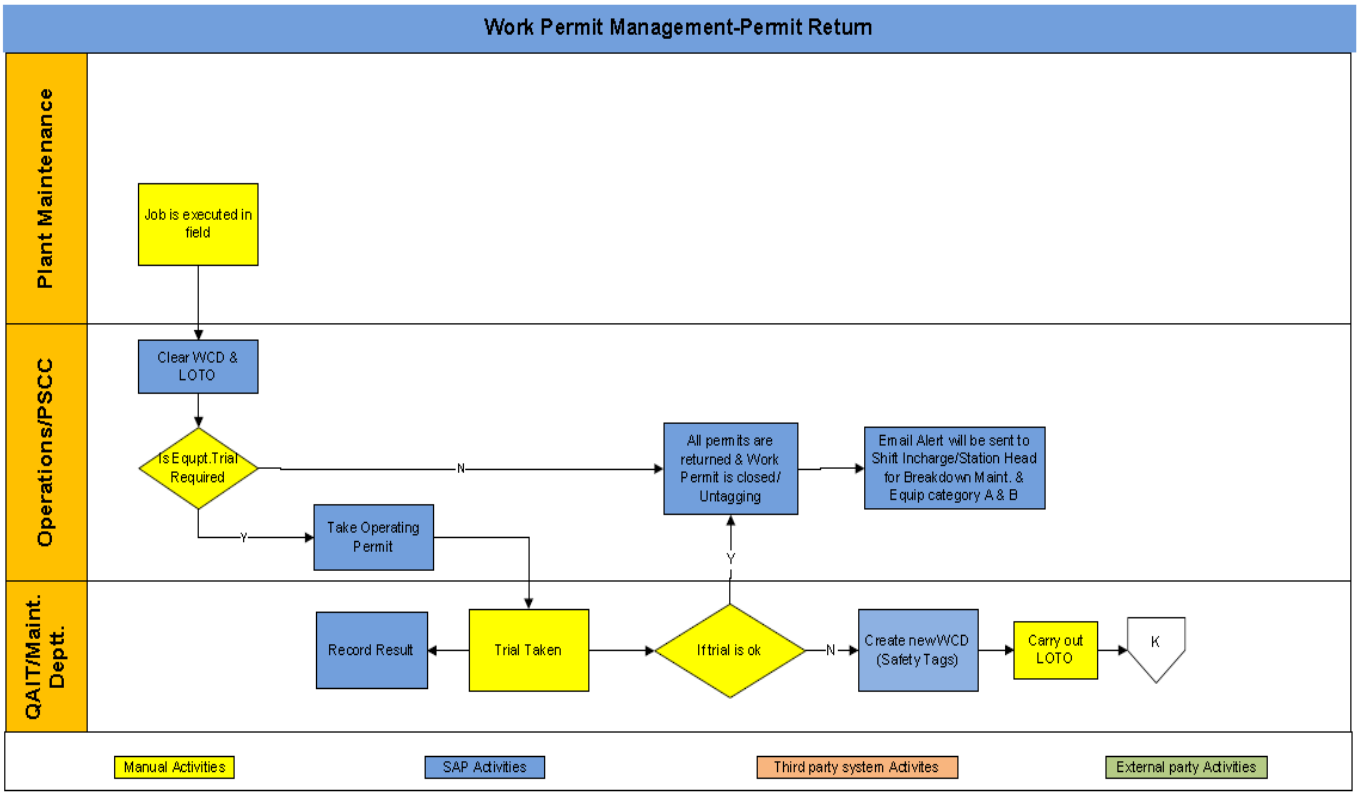
Permit -To-Work (PTW) Issuance Process



Annexure- 2

Sheet 2

Permit-To-Work (PTW) Return Process



Annexure- 3

SAP Permit-To-Work (PTW) Process Flow (Tabular Form)

Work Step #	Work Step Description	SAP T-code/Out of SAP/Other
Permit Issuance Process		
1	Create Work permit in maintenance order	IW31/IW32
2	Identify affected departments & types of work permit required for the job like PTW (Hot Work Permit, Confined Space)	IW32/IPMD
3	Attach JSA/HIRA if required	
4	Prepare the work Permit & inform operations for approvals.	WCLE
5	Can maintenance of equipment be done? (YES:7 NO:6)	Manual
6	Reject the work Permit Document with comment and Email alert to all the concerned Dept	WCLE
7	Approve Permit	WCLE
8	Are other maintenance dept involved? (YES:9 NO:12)	Manual
9	Notify relevant departments	Workflow
10	Preparedness is ensured	Manual
11	Confirm preparedness	WCLE
12	Print Permit Document & TAGS	WCLE
13	Carry out Isolations at site/LOTO & inform the concerned to activate the work Permit	Manual
14	Safety tags are assigned	Manual
15	Activate Work Permit/Tagging	WCLE
16	Email alert to person who created the order	Workflow
Permit Return Process		
1	Job is executed in field	Manual
2	Clear WCD and LOTO	WCLE
3	Is Equipment trail required (YES 4, NO 10)	Manual
4	Take Operating Permit	
5	Trail Taken	Manual
6	Record Results	
7	Is Trail is OK (YES 10 NO 8)	
8	Create new WCD/Safety Tags	WCLE

9	Carry Out LOTO	Manual
10	All permits are returned & Work Permit is closed/Untagging	WCLE
11	Email alert will be sent to Shift In Charge/Section Head for breakdown Main for Equipment Category A and B	Manual

Annexure- 4

SAP Standard Report

Report title	Transaction code (SAP GUI)	Comment
List Work Approvals	IP16	A list of all work approvals will be displayed with respective status such as ‘created’, ‘closed’, etc.
List Work Clearance Applications	WCL6	A list of all work clearance applications will be displayed
List maintenance orders	IW39	A list of all selected maintenance orders is displayed.
Equipment list	IH08	An equipment list with general data and more information.
List of Work Clearance Document templates	WCL2	A list of all work clearance document templates will be displayed

TPSMS/CSP/PTW/008/FORM/001 **Annexure- 5**

Permit-To-Work (PTW) Revalidation

Details:	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Date:						
Time: From						
Time :To						
Signature & Name of Permit Issuer						
Signature & Name of Permit Accepter / Holder						
Signature & Name of Area Operator (if applicable)						

TPSMS/CSP/PTW/008/FORM/002 **Annexure- 6**

Tool-Box-Talk (TBT) Record

Tool-Box-Talk (TBT) Date :
Location/Venue :
Permit-To-Work (PTW) No. :

Time :
Tool Box Talk conducted by :
Name of the Contractor / dept. :
Name of the Contractor's Supervisor :
Number of Workmen Present :

COMMON POINTS TO BE DISCUSSED	STATUS	Brief Discussion on Job to be performed
• Use of proper PPEs		
• Use of proper Tools		
• Barriers & Signs		
• Emergency Vehicle & First Aid Box		
• Enquiry of Health Status		

SN.	Name of the Workmen	Gate Pass No.	Sign
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

15			

Sign & Name of Tool-Box-Talk (TBT) conducted by:

JOB SAFETY ANALYSIS (JSA) PROCEDURE

Rev No.	Reason for Revision	Prepared By	Checked By	Approval by
Rev 00	Initial Release	Navendra Singh	Sanjay Kale	Shrinivas Katti
Rev 01	To implement Tata Power JSA Standard	Navendra Singh (Group Head – P & CB; Corp Safety.)	Rajesh Sharma (Head – Crop. Safety Operation)	Vijay Chourey (Chief – Corp Safety)

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1. **OBJECTIVE:** Objective of this procedure is to have a task/job based risk assessment process in place that identifies, evaluates and controls the risks associated with work activities, and as a result, prevents those involved in the task or those potentially affected by the task, from being harmed.

2. **SCOPE:** This procedure applies to all operating and project sites of Tata Power Group companies. A JSA (Job Safety Analysis) Shall be carried out:
   2.1. When new / different people will be undertaking the job for which an SOP / SMP is available

   2.2. When a non-routine task is to be undertaken

   2.3. When Job to be executed under Permit-To-Work (PTW)

   2.4. When deviations, due to some specific reasons, are required for Standard Operating procedure (SOP) / SMP (Standard Maintenance Procedure)

   2.5. Whenever a job with a Standard Operating procedure (SOP) / SMP (Standard Maintenance Procedure) is being undertaken in circumstances where the conditions of the job are changed with respect to the SOP/SMP. e.g. A welder working in his fabrication area will be covered by a SOP with HIRA already carried out, however, if the welding is being done on the site at a height or a confined space or in an area which may interfere with other jobs we need to conduct a JSA and use this in conjunction with the HIRA (Hazard Identification Risk Assessment) for the welding activity.

3. **EXPECTED RESULTS:**
   3.1. Manage Non routine jobs being done under permit-to-work safe.

   3.2. Manage Routine jobs being done under SOP/SMP.

   3.3. Control of incidents related to Routine & Non routine Jobs.

   3.4. Compliance to Regulatory requirements to make work place safety

4. **ACCOUNTABILITY & RESPONSIBILITY:**
   4.1. **ACCOUNTABILITY:** Concerned Division's Heads / Assets Custodian.
   4.2. **RESPONSIBILITY:** Concerned Engineer

5. GLOSSARY/ DEFINITIONS:

Hazard Identification & Risk Assessment: Hazard Identification & Risk Assessment is to identify and evaluate the hazards, Risk and put controls measures for safe execution of activities.

Hazard: Source or situation with potential for harm, something that can cause body injury / occupational illness, damage company property.

Job: A piece of physical work defined by time or other limits and that has a clear start and end point

Job Safety Analysis: Job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job. In a JSA, for each basic step of the job, it is to identify potential hazards and to recommend the safest way to do the job.

Non Routine Job / Task: Where an SOP / SMP is not available or the conditions of the SOP / SMP have changed

Risk Assessment: A systematic and structured process whereby hazards present in a workplace, or arising from workplace activity, are identified, risks assessed

Risk: The likelihood (probability) which can lead to potential negative consequences.

Severity: The level of consequence / harm of an event that could occur due to exposure to the hazard present

SOP: Standard Operating Procedure

SMP: Standard Maintenance Procedure

Shall: Mandatory requirement

Should: Optional requirement

Task / Activity: A sequence of steps taken to conduct a job. A task is a sub element of a Job.

6. PROCEDURES

6.1. The following criteria shall be used in determining whether HIRA or JSA will be required. Following illustrations may be useful to understand between selection of HIRA and JSA.

6.1.1. HIRA is activity specific like use of OXY-Acetylene Set for cutting.

6.1.2. JSA is Job specific like cutting of steam tubes using OXY-Acetylene set in the boiler

6.1.3. HIRA is Quantitative while JSA is Qualitative

6.1.4. HIRA primarily contain hazard & control measures specific to tools & equipment's and methodology to be used for the activity.

6.1.5. JSA contain hazards and control measure including to activity and site conditions where job to be accomplished.

6.2. For methodology and details about HIRA refer Tata Power Hazard Identification & Risk Assessment (HIRA) Procedure (TPSMS/GSP/HIRA/005).

6.3. Job Safety Analysis (JSA) involves the following:

6.3.1. Determining the scope of the job and listing the steps in the job.

6.3.2. Identifying possible hazards in the job.

6.3.3. Determining who and/or what is at potential risk

6.3.4. Describing the recommended safe way to do the job in order to prevent incidents and injuries.

6.3.5. Anticipating what might go wrong and devising back-up controls.

6.4. This will help to:

6.4.1. Identify and address hazards.

6.4.2. Prevent incidents and injuries.

6.4.3. Get organized to do the job right and more efficiently.

6.4.4. Create procedures that can be used by everyone.

6.4.5. Get people in the habit of working safely.

6.5. **Key Steps: The Job Safety Analysis consists of the following 6 steps**:

Step 1: Describe the job and the sequence of job steps

Step 2: Identification of the potential hazards of each step

Step 3: Determine who and/or what is at potential risk

Step 4: Description of the recommended safe job procedure

Step 5: Identification of what might go wrong

Step 6: Identification of back up controls

JSA should be done using SAP-EHS Modules. Alternatively it can be done using above 6 steps and format given in the Annexure 1.

6.6. Team Composition: The JSA is generally carried out by a team comprising;

6.6.1. Person/Team who do the work

6.6.2. Person supervising the job

6.6.3. Person with safety knowledge

6.6.4. Person (Specialist/Consultant) with technical knowledge

6.6.5. The number of team members will depend on and vary with the complexity of the job.

7. RECORDS :

7.1. Job safety analysis (JSA) (TPSMS/CSP/JSA/009/FORM/001)- Retention 12 Months

8. TRAINING & COMMUNICATION

8.1. Training of procedure shall be covered along with Permit-To-Work (PTW) procedure as Safety Training Needs identified.

8.2. Initial Communication to be done through Corporate Communication, Email and subsequently shall be made available at safety portal at Sangam.

9. VERIFICATION

9.1. Verification of implementation shall be done during Permit-To-Work (PTW) audit, field safety visit and site inspections.

10. EXCEPTION: Any exception to this procedure Any Exception to this procedure shall only be done as per Document Control .Procedure (TPSMS/GSP/DC/014)**.**

11. REFERENCES

- Tata Group Job Safety Analysis (JSA) Standard
- Tata Power Permit-To-Work (PTW) procedure (TPSMS/CSP/PTW/008)
- Tata Power Hazard Identification & Risk Assessment (HIRA) Procedure (TPSMS/GSP/HIRA/005)

12. REVIEW: Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in Incident investigation reports may be inputs for the review and revision of the procedure.

13. ATTACHMENTS/APPENDIX :

13.1. Annexure – 1: Sample Format for Job Safety Analysis (JSA) (TPSMS/CSP/JSA/009/FORM/001)

Annexure - 1

TPSMS/CSP/JSA/009/FORM/001

JOB SAFETY ANALYSIS

Division			
Job Title			
ID / Order No/ PTW No			
Job to be performed by	Tata Power / Contractor		
Date			
Tag No			
JSA Team / Assessment Team			
Name			
Role	Team Member	Maint. Engineer	HOD
Generated by			
Name	(Maker)		(Checker)
Company /Contractor			

Locations

Job Location

Analysed Job

Job Steps, Hazards and Controls

Sr. No.	Activities	Hazard	Required Control	Person Responsible

To be filled before applying for PTW

All above activities, Hazards, Controls have been explained to M/S _____
and are required to be followed by M/s _____.

ELECTRICAL SAFETY PROCEDURE

Rev No.	Reason for Revision	Prepared By	Checked By	Approval by
Rev 00	Initial Release	Ali Mohammed Zulphekari	Navendra Singh	Shrinivas Katti
Rev 01	To align with Tata Group Safety Standard	Ali Mohammed Zulphekari (Team Lead - QA,I&T)	Navendra Singh (Group Head – P & CB; Corp Safety.)	Vijay Chourey (Chief – Corp Safety)

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1. OBJECTIVE:

The objective of these procedure is to specify minimum mandatory requirements and advisory guidance for identifying and controlling hazards to ensure 'Zero Harm' with regard to operation maintenance and testing of electrical equipment. The established documentation for the elimination and control of hazards is henceforth referred to as **Electrical Safety Procedure**.

2. SCOPE:

Applicable to Tata Power (Operating and Project sites) which cover but not limited to plant premises, switchyards, substations, offices etc.

3. EXPECTED RESULTS:

3.1. Manage activities/jobs associated with electrical hazards safely.

3.2. Control of incidents related to electrical shock and hazards.

3.3. Compliance to Regulatory requirements to make work place safe.

4. ACCOUNTABILITY & RESPONSIBILITY:

ACCOUNTABILITY: Concerned Division's Heads / Assets Custodian

RESPONSIBILITY: Concerned Permit-To-Work Approver/Receiver

LINE MANAGEMENT IN SBU'S AND SITES HAS THE RESPONSIBILITY TO IMPLEMENT THIS STANDARD

5. GLOSSARY/ DEFINITIONS:

ELCB: Earth Leakage Circuit Breaker

ELV: Extra Low Voltage (< 50V AC and < 120V DC)

HIRA: Hazard Identification and Risk Assessment

JSA: Job Safety Analysis

LOTO: Lock Out Tag Out

PPE: Personal Protective Equipment

PTW: Permit to Work

Shall: Mandatory requirement

Should: Optional requirement

TBT : Test Before Touch

Work Permit - The written or printed document that is issued to control working in operational area/ in vicinity of electrical equipments.

Work supervisor - A person who is authorized; to verify that all conditions for working have been met, to define ongoing precautions to maintain safe working conditions during the work, to authorize the work to occur, and to cancel the permit allowing the work; also known as proprietor, work group supervisor, or authorizing person.

6.0 PROCEDURES

6.1 ESSENTIALS

6.1.1 Personnel (both Company employees and Contractors) shall be competent to carry out electrical work and shall possess Tata approved government authorized competency certificate for work at working voltage levels.

6.1.2 Employees/contractors working on/near electrical equipment shall be trained in emergency response/first aid.

6.1.3 Prior to carrying out any activity related to operation, maintenance or testing of electrical equipment, it shall be ensured that there is an appropriate Job Safety Analysis (JSA) supported with Hazard Identification and Risk assessment (HIRA) done and recorded.

6.1.4 Fire and explosion hazards associated with electrical equipment shall be assessed and managed.

6.1.5 Permit to Work (PTW) - TPSMS/CSP/PTW/008, and Lock Out Tag Out (LOTO) - TPSMS/CSP/LOTO/001 Procedures to be followed.

6.1.6 All electrical work shall be done in compliance to Standard Operating Procedure (SOP)/ Standard Maintenance Procedure (SMP).

6.1.7 Checklist should be made available and filled up copies recorded.

6.1.8 Isolation and subsequent confirmation test shall be carried out to verify absence of voltage.

6.1.9 Authorized Work Area cordoning off by barricading tape/Hard barricades shall be done prior to maintenance/testing.

6.1.10 Proper illumination shall be provided if the work has to be continued during dark hours. If any hand lamp is to be used it should be of voltage level equal to or less than 24V AC.

6.1.10 Hazard/flashing lights shall be installed if the work involves HV testing at 1 kV and above.

6.1.14 The room in which work is being carried out should have adequate ventilation system and emergency exit points. Adequate communication systems should be made available.

6.1.15 While working in the vicinity of live equipment the Engineer to whom PTW has been issued shall give proper information to PSCC and instructions to Staff carrying out work.

6.1.16 Appropriate PPE and adequate safety apparel like arc suits shall be worn.

6.1.17 Certified and insulated tools shall be used while performing electrical work.

After completion of work the Removed material shall be stored / shipped to safe location.

6.1.18 After completion of work Permit Issuer shall physically check and ensure that the following are cleared before closing of PTW.

a. Grounds
b. Tools
c. Spares
d. Personnel
e. Debris
f. Scrap

6.1.20 All Electrical equipment, spares and tools should be inspected and maintained at regular intervals as per proper approved schedule.

6.2 COMPLIANCE TO WORK PROCEDURES

6.2.5 Persons who work near electrical equipment and are potentially exposed to electrical hazards, shall be made fully aware of the hazards and should be suitably trained on how to work safely. All the work procedures should aim at minimizing exposure to electrical hazards to an acceptable level on the basis of HIRA.

6.2.6 Energy isolation shall be done before carrying out work on electrical equipment as per Lock out Tag out (LOTO) procedure.

6.3 WORKING ON OR NEAR ELECTRICALLY ENERGIZED EQUIPMENT

6.3.1 Work on or near any live conductor shall be carried out only in case of exceptions, after a thorough HIRA has been carried out.

6.3.2 When working on or near energized electrical equipment it shall be ensured that no other work should be performed within the prohibited approach boundary. (Work in switchyard, multi circuit tower with other lines charged)

6.3.3 Permission to work on such locations requires authorization from a senior authorized person/Engineer in charge (as per company standard/procedure) regardless of the PPE used or design of equipment. Appropriate control measures and suitable precautions (including the provision of suitable PPE) have been taken.

6.3.4 Energised Equipment may include working on both Extra Low Voltage (ELV) systems (<50 AC or < 120 DC) and non ELV systems

6.3.5 Testing which calls for Voltage injection is allowed within the prohibited approach boundary provided proper test equipments and PPE are used and the personnel are competent and qualified.

Recommended PPE: Helmet, voltage rated hand gloves, safety shoes, safety goggle with face shield, FR (Flame Resistant) coat, gas mask, acid resistant aprons.

6. 4 TESTING FOR ABSENCE OF VOLTAGE

6. 4.1 All circuits are considered energized until verified dead by testing it with appropriate instruments such as non-range selectable voltage indicators (Common DC/AC range voltmeter while verifying whether LV circuits are de-energised)

6. 4.2 All MV Cable Compartments of switchgears shall have back charge indicators. These back charge indicators shall be checked for no voltage before accessing the cable compartment. The healthiness of these back charge indicators must be monitored as per Standard Operating Procedure (SOP)/ Standard Maintenance Procedure (SMP).

6. 4.4 Ensure metallic segregation of Bus side (source) and Cable side (load) Compartment before entering any compartment for maintenance testing inspection. Metallic segregation shall be ensured between cable side (load) compartments.

6. 4.5 Ensure that all test instruments or equipment used are designed and certified to meet the requirements and are rated in all aspects for the category of the task to be performed.

6. 4.6 Practice of “Test Before Touch” (TBT) and performance of positive confirmatory test of the instrument before every use should be followed. Insulation healthiness level of test instrument should be confirmed before using them as it is likely to be in contact with a live 220 kV line. Insulation should be physically checked for cleanliness, dryness and free of cracks/breakages. Always store such instruments in protected cases.

6. 4.7 Recommended PPE: Helmet, Shoes, voltage rated hand gloves, safety shoes, safety goggles with face shield and Flame Resistant coat.

6. 5 DISMANTLLING OF ELECTRICAL RACEWAYS AND CABLES

6.5.1 The identification, cutting, and removal of electrical raceways and cables often involve a high level of risk in determining that cables are not damaged while removed cable trays and that in case of cable removal the correct cable is removed.

6.5.2 The cable left behind after removal of cable tray must be adequately supported and protected from damage by adjacent equipment, moving parts, UV rays, hot pipe lines, etc.

6.5.3 Maintain proper labelling and identification of cables at both ends to avoid the error of mistaken identity (Refer Lockout Tag Out Procedure).

6.5.4 Test for the absence of voltage at the source and destination ends of each cable. Follow live cable identification procedures and positively identify each cable before it is cut.

6.5.5 Ensure all protection and isolation system are working.

6.5.6 A good practise would be to positively identify other cables in the vicinity.

6. 6 RELOCATION OF EQUIPMENT

6.6.1 Before relocation of equipment / electrical systems from one place to another a formal risk assessment should be carried out.

6.6.2 When equipment / electrical system are relocated to a new place it shall be ensured that it will work in a safe manner.

6.6.3 Alternate power supply should be made available during relocation work wherever applicable/possible. This will improve availability and reduce pressure of time constraint while carrying out replacement job.

6. 7 EXCAVATIONS AND DRILLING IN WALLS

6.7.1 Ensure that the electrical lines, conduits, and cables in the area of work activity are identified before performing excavation and drilling of floors, roofs, walls.

6.7.2 Up-to-date maps / drawings/electronic tracers systems may be used for locating underground / concealed cables

6.7.3 GIS system may be referred to wherever it is available.

6.7.4 Prior to excavation and penetration, it shall be ensured that there is an appropriate Job Safety Analysis (JSA), Permit to Work (PTW) and Lock Out Tag Out (LOTO) compliance supported with Hazard Identification and Risk Assessment (HIRA).

6.8 MANAGEMENT OF ELECTRICAL HAZARDS

6.8.1 SHOCK HAZARD

The following technologies should be adopted to complement the overall shock protection program and to minimize the risk of shock:

a. Voltage-rated gloves shall be worn wherever a shock hazard is present.
b. Proper design, installation, and maintenance of equipment earthing which is critical to managing shock hazards shall be ensured.
c. Installation of RCCB (Residual Current Circuit Breakers)/ELCBs (Earth Leakage Circuit Breaker) shall be carried out based on the company's standards / procedures. Periodic test of RCCB/ELCB should be carried out.
d. Battery-powered tools instead of AC power driven tools to be used wherever possible.
e. Reduced-voltage equipment
f. Double-insulated equipment
g. Shrouding and barriers
h. Insulated or voltage-rated tools
i. Voltage-rated PPE (e.g., gloves or helmets)
j. Insulated mats for floors
k. Insulated, flexible barriers for exposed equipment parts
l. Identification of multiple voltage sources inside cabinets
m. Segregated voltages to prevent accidental contact where multiple voltage sources exist in one unit, terminal blocks, marshalling boxes,
n. Finger-safe terminals to prevent finger contact
o. Prohibited approach boundary limit for circuit parts and conductors shall be crossed only by a qualified and competent person under the written authorization from management.

6.8.2 ARC / FLASHOVER HAZARDS

Arcing faults in electrical equipment are multi-energy events (i.e., involving heat, blast, light, and sound) that generally produce high levels of energy release in a short-duration.

a. It takes place due to phase to phase and phase to earth fault conditions. It may cause heavy flashover which may result in severe injury to employees in the close vicinity.
b. Tata Power shall clearly specify the level of Incident Energy above which the recommended PPE's (such as cool coat, face shield with goggles, safety shoes, hand gloves and insulated electrical hand tools) are to be used.
c. Areas where dangers of Arc/Flashover hazards can occur should be identified.
d. There should be warning boards wherever use of ARC SUIT is mandatory.
e. This phenomenon can occur at low voltage levels as well.

Areas where dangers of Arc/flashover hazards can occur should be identified. There should be warning boards wherever use of ARC SUIT is mandatory.

6.8.3 STATIC ELECTRICITY HAZARDS

a. Static electricity hazards, including lightning can be a source of ignition, and injuries. It can result in shock to personnel and damage to equipment directly. It may also lead to fires.
b. Some operations (e.g. handling or transporting liquids, solids, or gases in portable containers or piping systems) generate static electricity hazards.
c. Certain maintenance activities (e.g. steam cleaning, industrial vacuuming, and sandblasting), generate static electricity hazards.
d. Ensure proper earthing and bonding of earthing conductors to equipment and structures to prevent generation of static electricity.
e. Each site shall be equipped with adequate lightning arrestors (Refer to local standards / regulations for guidance).

6.8.4 FIRE AND EXPLOSION HAZARDS

Assess and manage the risk of explosion hazards associated with electrical equipment .e.g. Hydrogen filled generators. These should include, but are not limited to:-

a. Provision and maintenance of drawings and documents describing the limits of the hazardous area and its classification.
b. Selection and procurement of electrical and non-electrical equipment appropriate for the area classification (refer note below).
c. Maintenance of the mechanical integrity of the installation, including grounding and bonding.
d. Promptly arresting the leakage of combustible gases and liquid and avoid accumulation of combustible waste.
e. No hot work to be carried out without “HOT WORK PERMIT”
f. In the absence of Work Permit System in that particular site, a system should be put in place to ensure that hot work is conducted in a safe and secure manner

6.8.5 FLAMMABLE AND TOXIC GAS HAZARDS

a. Assess and manage the risk of hazards associated with handling flammable and toxic gases. These include Cl2, SF6, H2, N2, CO2, Furnace Exhaust gases, (while working in ESPs, Chlorination Plant, Chimney, Boilers)
b. Promptly arresting the leakage of combustible gases and liquid and avoid accumulation of combustible waste.
c. Warning signs shall be put up with instruction for emergencies.
d. No hot work to be carried out near flammable gases.

Note: Entry into these areas by electrician may be required for installation of lighting purposes.

6.8.6 MECHANICAL ENERGIZED SPRING HAZARDS

a. Assess and manage the risk of hazards associated with Mechanically Charged Springs.
b. Ensure all springs are discharged before maintenance activity is carried out.
c. When work to carried out in vicinity of charged springs adequate knowledge of the hazards associated should be possessed. Ensure that either the springs are discharged or they are in locked in position.

6.8.7 PRESSURIZED GAS CYLINDER HAZARDS

a. Assess and manage the risk of explosion hazards associated with Pressurized Gas Cylinders.
b. Follow Tata Power Safety Procedures for Handling and Storage of Pressurized Gas Cylinders.
c. Empty Cylinders should be clearly identified.
d. All Cylinders should be stored vertically.

6.8.8 BATTERY ACID HANDLING HAZARDS

6.8.8.1 Storage of Acid Cans/Containers

a. Acid cans should be clearly labelled with danger sign.
b. Emergency Contact Numbers should be clearly printed.
c. Board with Instructions for actions to be taken in case of emergency should be put up at entrance to storage area.
d. It should be fool proof against mistakenly being taken to be water.
e. Acid containers should be stored away from reach of general public.
f. Adequate ventilation should be provided.
g. Availability of fire fighting equipment should be ensured.
h. Provision of eye wash and shower should be ensured.
i. Containers should be durable and UV proof
j. Do not bring naked flame in vicinity of storage area
k. Never pour water into concentrated acid for preparation of dilute acid.
l. Acid should be handled by approved personnel
m. Necessary PPE should be used before handling Battery Acid.
n. Instrument used for measuring specific gravity should be calibrated.

6.9 PERMIT TO WORK (PTW), LOCK OUT TAG OUT (LOTO), HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA)

6.9.1 Documented “Permit to Work (PTW) System” shall be implemented with total compliance to LOTO.

6.9.2 Concept of test before touch should be followed by everyone working with electrical systems.

6.9.3 Control circuit isolation is not considered safe for electrical working.

6.9.4 Power circuit of all voltage levels shall be isolated, locked and tagged. Keep in mind that 415V power circuit are equally hazardous especially in case it is fed directly from transformer output.

6.9.5 Permit for working on energized circuits shall be supported by HIRA and it shall be discussed with the working team for developing an understanding of involved hazards and precautionary measures.

6.9.6 After checking absence of voltage by neon tester of appropriate voltage rating, the discharging of residual charge from the cables, capacitors, transformers and other equipment by short circuiting and earthing should be done before touching un-insulated portion of the equipment.

6.10 TEMPORARY WIRING

6.10.1 Temporary wiring shall be done with all safety systems, ELCBs, warning signs, in place and in working condition.

6.10.2 Knowledge of source isolation points shall be known to the working personnel.

6.10.3 Wiring for temporary supply shall be done with proper plug and socket arrangement.

6.10.4 Proper earthing should be applied to all equipment and tools used.

6.10.5 Temporary wiring will be allowed only in the following cases:

a. Construction, remodelling, demolition of buildings and / or structures. Maintenance, repair of equipment

b. Emergencies, testing activities, experiments and developmental work

c. Temporary wiring shall be removed immediately upon completion of construction, or the purpose for which it was installed

6.10.6 Special precautions should be taken in case of temporary wiring installation. The precautions taken shall provide a level of safety equivalent to or greater than that provided by fixed / permanent wiring.

6.11 EARTHING

6.11.1 All extraneous metal parts of an electrical installation and adjacent metal work shall be connected to earth.

6.11.2 The design of the earth system shall take into account the protection of life from raised voltages on external parts and the correct operation of the electrical protection systems.

6.11.3 Dual earthing should be provided.

6.11.4 Appropriate means shall be used to test the integrity of earthing systems periodically.

6.11.5 The design of the system should consider the requirement to test wherever possible.

6.13.6 Proper symbols and colour codes should be used for earthing system.

6.13.7 Earthing System should be theft proof. In case of theft it should be replaced immediately.

6.14 OVERHEAD LINES

6.14.1 Work in areas where overhead lines are present should be monitored carefully. A formal risk assessment / Job Safety Analysis shall be carried out and adequate precautions taken before such work is permitted.

6.14.2 Adequate precautions should be taken while using long length equipment and tackles in these areas.

6.14.3 Reduction in clearances should be considered while working in vicinity of HV lines.

6.14.4 Personnel working in these areas should be aware of Induction Voltages present.

6.14.5 Personnel should be alert to fault occurring on adjacent lines.

Working at height Procedure shall be followed.

6.15 OTHER ASPECTS

6.15.1 Access to high tension areas and vital installations shall be controlled.

6.15.2 Access control should be maintained for Capacitor Bank Cages

6.15.3 Appropriate signage shall be displayed in hazardous areas and on equipment as per statutory requirements.

6.16 SAFETY PRECAUTIONS WHILE CARRYING OUT TESTING OF EQUIPMENT RELAYS INSTRUMENTS

a. Instruction Manuals of equipment shall be studied before carrying out any activity.
b. LOTO system will be used for de-energizing stored energy.
c. Working at Heights Standards shall be referred wherever appropriate.
d. While working in switchyard one must be aware of levels of induction voltages and its dangers to personnel and test equipment.
e. Umbrellas and metallic ladders shall NOT be used in the switchyard.
f. Transportation in switchyard shall be done considering safe clearances.
g. While working with SF6 environmental precautions shall be strictly followed.
h. Other standards wherever applicable shall be adhered to.

6.17.1 SAFETY PRECAUTIONS DURING HIGH VOLTAGE TESTING

a. Before Hi-pot of any equipment get confirmation of the test voltage to be applied.
b. Before Hi-pot flashing light and alarm system should be made available.
c. Before Hi-pot of any equipment, conduct the leakage current trial trip test of the test set by grounding the equipment under test.
d. Discharge all equipment by proper discharge rod after every Hi-pot test.
e. Ensure proper duration of discharge
f. While doing Hi-Pot ensure that IR shall be taken before and after test.
g. Ensure minimum value of IR is met before Hi-Pot test.
h. While doing Hi-Pot ensure proper cordoning of the area under test
i. Testing engineer should maintain safe distance from high voltage by locating control unit outside cordoned area
j. After every test before discharging, isolate 230 V AC power supply by physically removing three pin plug from socket.

k. Discharge after DC Hi-Pot should be very slow, gradual and will consume more time.

l. Ensure proper identification and connection of phase and neutral of variac for input to the kit.

m. Ensure firm connection of leads so that they do not break fall while the test is in progress

6.17.2 SAFETY PRECAUTIONS WHILE TESTING TRANSFORMER

a. While doing magnetic balance test from LV side, ensure that the HV side is not shorted and clearances for induced HV voltages are taken care of. The area should be well cordoned-off to prevent anybody from coming close to the equipment which may include connected switchgear.

b. While doing magnetic balance (without variac) with one shot direct voltage application, ensure proper ELCB protection on supply side to take care of inadvertent shorting on secondary side or fault in transformer.

c. While arranging for silica gel replacement ensure Buchholz relay trip and PRD trip is taken care of.

d. Before clearing transformer for charging confirm that the transformer neutral has been earthed.

e. Before clearing transformer for charging ensure that unused transformer CT cores are shorted and grounded in its marshalling boxes.

f. No transformer should be cleared for charging without all device trials.

g. Ensure proper and safe discharge of transformer after every HV test (e.g. IR, HV tan delta, etc.)

h. Ensure firm connection of leads so that they do not break and fall while the test is in progress

i. Do not touch any exposed leads for making connections without insulated rubber hand gloves.

j. Winding Resistance: After discharge of winding by test set, Switch off test supply. While changing the lead connection for different phase measurement, ensure supply plug is disconnected in addition to the above. Additionally, a banana

shorting across terminal of transformer or test set may be used to ensure complete discharge.

k. TTR / Voltage Ratio / Vector Group Test: Test should be done by injecting voltage on HV side

l. Buchholz trials to be conducted by draining oil. Ensure all the related isolating valves are opened after the test and proper venting is done.

m. WTI / OTI Maximum Temp Indicator should be noted before the test and should be set to same value after the test. During this test ensure that All fans and pumps are ready for operation.

6.17.3 SAFETY PRECAUTIONS WHILE TESTING TRANSFORMER BUSHING

a. Test tap is normally rated up to 1 kV and should be grounded in service condition. During HV tan delta, the connection to test tap point should be made firmly so that the leads do not come out while test is in progress.

b. Ensure proper connection of HV lead to the bushing HV cylinder. Connection to conductor coming out of bushing need not always be connected firmly to bushing cylinder in case through put bushing.

c. Ensure proper grounding and protection from moisture ingress of the test tap after completion of the test.

6.17.4 SAFETY PRECAUTIONS WHILE TESTING CT / CVT / PT

a. Test tap is normally rated up to 1 kV and should be grounded in service condition. During HV tan delta, the connection to test tap point should be made firmly so that the leads do not come out while test is in progress.

b. Ensure proper grounding and protection from moisture ingress of the test tap after completion of the test.

c. While doing primary injection ensure LBBU, B/F and Transformer differential relay are properly identified and blocked if necessary.

d. While bypassing i.e. connecting measuring instrument across CT links and dropping them for current measurements, ensure continuity of current measuring circuit. There should be no fuse in that measuring circuit.

e. After raising CT link by two screw driver method only, ensure current in the test measurement circuit for which the link was dropped has gone to zero.
f. Do not short secondary of CVT/PT
g. While doing CVT/PT secondary voltage injection ensure the HV side is not shorted and that it is cordoned off and protected.
h. Do not leave any CT secondary open circuit
i. There should be only one ground in each core / winding of CT/CVT/PT secondary circuit.
j. Follow the instructions of HV Test Kit while doing secondary induced voltage testing on PT.

6.17.5 SAFETY PRECAUTIONS WHILE TESTING CAPACITOR BANK

a. While entering Capacitor bank cage ensure that it is fully discharged.
b. Do not reclose capacitor bank breaker immediately after tripping.
c. Ensure Discharge Timer in Protection circuit for the above.
d. One must be aware of the corrosive and dangers of the electrolyte in the capacitor
e. Ensure proper Voltage and KVAr rating of the capacitor being commissioned /replaced.

6.17.6 SAFETY PRECAUTIONS WHILE TESTING GENERATOR

a. While entering GT/UAT/Generator HV side bus duct, etc. ensure that the generator is at standstill and not on turning gear. Ensure primary drive is isolated.
b. Ensure to disconnect space heater supply during work. If space heater is to be kept in service this condition should be clearly highlighted. Space heater terminals should be adequately covered to prevent personnel coming in contact to live terminals. Precaution against contact with hot surface of space heater should also be taken.
c. Ensure that Generator is not taken on turning gear when testing in Generator Bus duct is in progress.
d. Ensure proper sound protection for ears while working in vicinity of running generators
e. While doing generator shaft voltage measurements ensure proper safety.

f. In case of Hydrogen filled generators follow the laid down procedures as Hydrogen gas is highly explosive.
g. Ensure decoupling of generator from primary mover where ever possible. The isolation valves to the turbine should be closed.

6.17.7 SAFETY PRECAUTIONS WHILE TESTING MOTOR

a. Ensure that the motor is at standstill and not on turning gear. Even after standstill ensure the windings are discharged before testing.
b. It should be decoupled from load. The motor should not drive the load and vice versa the load should not rotate the motor during testing.
c. Ensure to disconnect space heater supply during work. If space heater is to be kept in service this condition should be clearly highlighted.
d. Space heater terminals should be adequately covered to prevent personnel coming in contact to live terminals.
e. Precaution against contact with hot surface of space heater should also be taken.
f. Ensure that Motor is not taken on turning gear when testing.
g. Ensure proper sound protection for ears while working in vicinity of running motors
h. While disconnecting motor make sure to note down cable connections to prevent reverse rotation. One should ensure correct rotation of motor before coupling to load after overhaul or testing. Wrong direction of rotation may cause severe damage.

6.17.8 SAFETY PRECAUTIONS WHILE TESTING SWITCHGEAR

a. Ensure all entry points and doors are closed and vermin proof before clearing equipment.
b. Especially for outdoor equipment ensure proper monsoon, water ingress protection.
c. During Testing, do NOT put hands in moving parts of breaker mechanism
d. While entering cubicle for CT or PT connection, ensure metal clad isolation between live bus bar compartment & cable compartment of feeders, incomers etc.
e. IR of Vacuum bottle must be done with X-Ray exposure shield.

6.17.9 SAFETY PRECAUTIONS WHILE TESTING RELAY

a. While doing carrier trials ensure that it is not used for direct trip as a special case.
b. During testing ensure isolation of relay binary outputs accounted for. There should be no Remote, Bus Coupler, Lock Out tripping (other than the feeder which is being tested) connected.
c. Confirm B/F, Differential Stability, Shinkle test while taking new equipment in service.
d. Test charge equipment with B/F, LBBU kept inoperative. These should be taken into service after spill current measurements.
e. Ensure safety ground in CT and PT secondary circuits.
f. Ensure DC on while carrying out changeover before release so the juice is available for changeover relays.

6.17.10 SAFETY PRECAUTIONS WHILE USING TEST INSTRUMENT

a. Ensure proper grounding of test instruments especially while working in High Voltage areas
b. Ensure proper grounding of equipment under test before test lead connections
c. Ensure all grounds are removed after completion of all tests.
d. Do final Maintenance IR measurement before charging the equipment.
e. Use of Dimmerstat should be done keeping in mind that both phase and neutral may have high voltages with respect to ground.
f. Dimmerstat body should be earthed properly before it is used.
g. Before HV tan delta measurement at high voltage do one reading at low voltage to ensure healthiness of circuit.
h. Keep all test instruments in cool place/shaded area for protection against heat.
i. Ensure field calibration of instrument if required, e.g. leads of SFRA test set.

6.17.11 GENERAL SAFETY PRECAUTIONS WHILE TESTING

a. Cross check if any doubt about test results or variations in test results.
b. Wherever working with high pressure vessels/ cylinders person must be aware of the dangers.

c. Wherever working with corrosive liquids like battery acid, cleaning liquids, alcohol all precautions and emergency procedures are understood.

6.17.12 SAFETY PRECAUTIONS FOR POWER SUPPLY USED FOR TESTING

a. Ensure ELCB.
b. Test ELCB.
c. Ensure 3 pin plugs for 1 phase supply.
d. Ensure proper earthing of the earth point in the supply system.
e. Ensure healthiness and firmness of Phase Neutral and Earthing wire connections.
f. Measure the supply voltage.
g. Ensure adequate rating of supply point so that ELCB / MCB do not trip during test.
h. Ensure proper phase sequence in case of three phase supply.
i. Ensure adequately rated cables and hardware.

7.0 RECORDS :

All Check Lists as annexed with this procedure. Records to be kept minimum three years.

8.0 TRAINING & COMMUNICATION

8.1 Training of procedure shall be covered as part of electrical safety Training.

8.2 Initial Communication to be done through Corporate Communication, Email and subsequently shall be made available at safety portal at Sangam.

9.0 VERIFICATION

9.1 Verification of implementation shall be done during safety audit, field safety visit and site inspections.

10.0 EXCEPTION: Any Exception to this procedure shall only be done as per Document Control .Procedure (TPSMS/GSP/DOC/014).

11.0 REFERENCES

11.1 Tata Group Job Safety Analysis (JSA) Procedure - TPSMS/CSP/JSA/009

11.2 Tata Power Permit-To-Work (PTW) Procedure - TPSMS/CSP/PTW/008

12.0 REVIEW: Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in Incident investigation reports may be inputs for the review and revision of the procedure.

13.0 ATTACHMENTS/APPENDIX :

SAFETY CHECK LIST FOR TESTING ACTIVITIES: In addition to checklist given below each division shall prepare its own equipment specific checklist. PTW acceptor (usually the O&M engineer in the particular shift) and testing engineer shall fill the checklist before carrying out any testing activity and keep signed copy for record. The check list is valid only once for the duration of the caution/release/operation order. List of Annexure enclosed in this procedures:

13.1 **Annexure-1**:Safety Check List for HV Testing :
TPSMS/CSP/ELEC/010/FORM/001

13.2 **Annexure-2**:Safety Check List for Transformer Testing :
TPSMS/CSP/ELEC/010/FORM/002

13.3 **Annexure-3**:Safety Check List for Transformer Bushing Testing :
TPSMS/CSP/ELEC/010/FORM/003

13.4 **Annexure-4**:Safety Check List for CT/CVT/PT Testing:

13.5 TPSMS/CSP/ELEC/010/FORM/004

13.6 **Annexure-5**:Safety Check List for Capacitor Testing:
TPSMS/CSP/ELEC/010/FORM/005

13.7 **Annexure-6**: Check List for Generator Testing:
TPSMS/CSP/ELEC/010/FORM/006

13.8 **Annexure-7**:Safety Check List for Switch Gear Testing :
TPSMS/CSP/ELEC/010/FORM/007

13.9 **Annexure-8**: Check List for Relay Testing:
TPSMS/CSP/ELEC/010/FORM/008

13.10 **Annexure-9**: Check List for Handling Test Instruments
TPSMS/CSP/ELEC/010/FORM/009

13.11 **Annexure-10:** Check List General For Testing Activity
TPSMS/CSP/ELEC/010/FORM/010

13.12 **Annexure-11**: Checklist for Power Supply Used for Testing:
TPSMS/CSP/ELEC/010/FORM/011

Annexure- 1

TPSMS/CSP/ELEC/010/FORM/001

SAFETY CHECK LIST FOR HV TESTING

DATE OF TESTING:----------

1	Hi-Pot Test Voltage to be applied available	____ kV	
2	Cordoning of the area under test done	Yes	
3	IR before Hi Pot test > 10 Mohm (>minimum value).	Yes	
4	Proper identification and connection of phase and neutral of variac for input to the kit.	Yes	
5	Flashing light, alarm system working.	Yes	
6	Testing engineer at safe distance from high voltage by locating control unit outside cordoned area	Yes	
7	Ensure firm connection of leads so that they do not break fall while the test is in progress	Done	
8	Leak trip test of Hi-pot set	Done	
9	After Hi-Pot test before discharging, isolate 230 V AC power supply by physically removing three pin plug from socket.	Done	
10	Equipment discharged for sufficient duration by proper discharge rod after Hi-pot test.	Yes	
11	Discharge after DC Hi-Pot should be very slow, gradual and will consume more time.	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 2

TPSMS/CSP/ELEC/010/FORM/002

SAFETY CHECK LIST FOR TRANSFORMER TESTING

DATE OF TESTING:----------

1	Magnetic Balance Test: While doing magnetic balance test from LV side the area should be well cordoned off to prevent anybody from coming close to the equipment which may include connected switchgear.	Done	
2	Magnetic Balance Test: While doing magnetic balance test from LV side, ensure that the HV side is not shorted and clearances for induced HV voltages are taken care of.	Done	
3	While doing magnetic balance (without variac) with one shot i.e. direct full voltage application, proper ELCB protection on supply side available to take care of inadvertent shorting or fault on secondary side of transformer.	Yes	
4	Transformer neutral has been earthed after test.	Done	
5	CT cores are shorted and grounded in its marshalling boxes.	Done	
6	Device trial alarm and trip done.	Yes	
7	Proper and safe discharge of transformer after every HV test (e.g. IR, HV tandelta, etc) done.	Yes	
8	Firm connection of test leads so that they do not break and fall while the test is in progress	Done	
9	Put on Rubber hand gloves before test lead connection.	Yes	
10	Winding Resistance: After discharge of winding by test set, Switch off test supply. While changing the lead connection for different phase measurement, ensure supply plug is disconnected in addition to the above. Additionally, a banana shorting across terminal of transformer or test set may be used to ensure complete discharge.		
11	TTR / Voltage Ratio / Vector Group Test: Test should be done by injecting voltage on HV side	Yes	
12	Buchholz trials to be conducted by draining oil.	Yes	
13	After Buchholz trials all the related isolating valves are opened and proper venting is done.	Yes	
14	WTI / OTI Maximum Temp Indicator noted before the test.	Yes	
15	WTI / OTI test all fans and pumps are ready for operation The fans are either covered or nobody is near the fan. Pump suction and discharge lines are lined up	Yes	
16	WTI / OTI Maximum Temp Indicator reset after the test.	Yes	

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 3

TPSMS/CSP/ELEC/010/FORM/003

SAFETY CHECK LIST FOR TRANSFORMER BUSHING TESTING

DATE OF TESTING:----------

1	During HV tan delta test, the test tap point should be connected firmly so that the leads do not come out while test is in progress.	Done	
2	Ensure proper grounding and moisture ingress protection of the test tap point after completion of the test.	Done	
3	Proper connection of HV leads to the bushing HV during test.	Done	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 4

TPSMS/CSP/ELEC/010/FORM/004

SAFETY CHECK LIST FOR CT/CVT/PT TESTING

DATE OF TESTING:----------

1	Secondary of CVT/PT kept open and grounded at one point.	Yes	
2	Secondary of CT kept shorted and grounded at one point.	Yes	
3	Before primary injection LBBU, B/F and Transformer differential relay are properly identified and blocked if necessary.	Yes	
4	There should be no fuses in the meters used for current measurements on CT secondary circuits.	Yes	
5	While dropping CT links for current measurements ensure continuity of current measuring circuit.	Yes	
6	After raising CT link by two screw driver methods only, current in the meter across the link has gone to zero before removing the meter.	Yes	
7	While doing CVT/PT secondary voltage injection ensure the HV side is not shorted and that it is cordoned off and protected.	Yes	
8	There should be only one ground in each core / winding of CT/CVT, PT circuit. IR of secondary circuit after removing single ground > 2Mohm	Yes	
9	Follow the instructions of HV Test while doing secondary induced voltage testing on PT.	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 5

TPSMS/CSP/ELEC/010/FORM/005

SAFETY CHECK LIST FOR CAPACITOR TESTING

DATE OF TESTING:----------

1	While entering Capacitor bank cage ensure that it is fully discharged.	Yes	
2	Do not reclose capacitor bank breaker immediately after tripping.	Yes	
3	Ensure Discharge Timer in Protection circuit for the above.	Yes	
4	One must be aware of the corrosive and dangers of the electrolyte in the capacitor	Yes	
5	Ensure proper Voltage and KVAr rating of the capacitor being commissioned /replaced.	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 6

TPSMS/CSP/ELEC/010/FORM/006

SAFETY CHECK LIST FOR GENERATOR TESTING

DATE OF TESTING:----------

1	While entering GT/UAT/Generator HV side bus duct, etc. ensure that the generator is at standstill and not on turning gear.	Yes	
2	Ensure that Generator is not taken on turning gear when testing in Generator Bus duct is in progress.	Yes	
3	Ensure proper sound protection for ears while working in vicinity of running generators	Yes	
4	While doing generator shaft voltage measurements ensure proper safety.	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 7

TPSMS/CSP/ELEC/010/FORM/007

SAFETY CHECK LIST FOR SWITCHGEAR TESTING

DATE OF TESTING:----------

1	Ensure all entry points and doors are closed and vermin proof before clearing equipment.	Yes	
2	Especially for outdoor equipment ensure proper monsoon, water ingress protection.	Yes	
3	During Testing, do not put hands in moving parts of breaker mechanism	OK	
4	While entering cubicle for CT or PT connection, ensure metal clad isolation between live bus bar compartment & cable compartment of feeders, incomers etc.	Yes	
5	IR of Vacuum bottle must be done with X-Ray exposure shield.	Yes	
6	DC clearance and AC clearance are adequate (of different criteria?)	Yes/NO	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Reviewed By (Name & Signature) :

Annexure- 8

TPSMS/CSP/ELEC/010/FORM/008

SAFETY CHECK LIST FOR RELAY TESTING

DATE OF TESTING:----------

1	Direct Trip links if any kept dropped during carrier trials	Yes	
2	During testing ensure isolation of relay binary outputs accounted for. There should be no Remote, Bus Coupler, Lock Out tripping (other than the feeder which is being tested) connected.	Yes	
3	Confirm B/F Stability while taking new equipment in service.	Yes	
4	Confirm Differential Stability test while taking new equipment in service.	Yes	
5	Confirm Shinkle test while taking new equipment in service.	Yes	
6	B/F, LBBU trip links kept inoperative for test charging and/or taking equipment on load service	Yes	
7	B/F, LBBU normalized after making spill current measurements.	Yes	
8	DC and Positive to Trip circuits IR taken.	Yes	
9	CT and PT secondary circuits IR taken.	Yes	
10	Ensure safety ground in CT and PT secondary circuits.	Yes	
11	Ensure DC on while carrying out changeover before release so the juice is available for changeover relays.	Yes	

Remarks (If any):

Prepared & Checked By (Name & Signature):

Reviewed By (Name & Signature):

Annexure- 9

TPSMS/CSP/ELEC/010/FORM/009

SAFETY CHECK LIST FOR HANDLING TEST INSTRUMENTS

DATE OF INSPECTION:----------

1	Proper grounding of test instruments especially while working in High Voltage areas	Yes	
2	Proper grounding of equipment under test before test lead connections	Yes	
3	All grounds are removed after completion of all tests.	Yes	
4	Final Maintenance IR measurement before charging the equipment.	Yes	
5	Dimmerstat leads and terminals properly covered (both phase and neutral may have high voltages with respect to ground.)	Yes	
6	Dimmerstat body earthed properly before it is used.	Yes	
7	Before HV tan delta measurement at high voltage do one reading at low voltage to ensure healthiness of circuit.	Yes	
8	Shaded area and table provided for all test instruments in field testing activity for protection against heat and rain.	Yes	
9	Field calibration of instrument carried out. (e.g. leads of SFRA test set.)	Yes	

Remarks (If any):

Prepared & Checked By (Name & Signature):

Annexure- 10

TPSMS/CSP/ELEC/010/FORM/010

SAFETY CHECK LIST GENERAL FOR TESTING ACTIVITY

DATE OF INSPECTION:----------

1	Cross check if any doubt about test results or variations in test results.	Yes	
2	Wherever working with high pressure vessels/ cylinders person must be aware of the dangers.	Yes	
3	Wherever working with corrosive liquids like battery acid, cleaning liquids, alcohol all precautions and emergency procedures are understood.	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

Annexure- 11

TPSMS/CSP/ELEC/010/FORM/011

SAFETY CHECK LIST FOR POWER SUPPLY USED FOR TESTING

DATE OF INSPECTION:----------

1	ELCB of adequate rating installed.	Yes	
2	3 pin plug for 1 phase supply.	Yes	
3	Ensure adequate sizing of power supply cables	Yes	
4	Confirm proper earthing of the supply earthing points.	Yes	
5	Ensure adequate rating of supply point so that ELCB / MCB does not trip during test	Yes	

Remarks (If any) :

Prepared & Checked By (Name & Signature) :

EARTH LEAKAGE CIRCUIT BREAKER (ELCB) TESTING PROCEDURE

Rev No.	Reason for Revision	Revised By	Checked By	Approval by
R0	On the basis of incident Investigation report	Ravindra Panchal	Navendra Singh	V K Chourey
R1	To add SOP of ELCB Testing	Ravindra Panchal	Navendra Singh	V K Chourey

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1. **OBJECTIVE:**

   The objective of this procedure is to define the minimum requirements for testing of Earth Leakage Circuit Breaker (ELCB).

2. **SCOPE:**

   This procedure applies to all operating & Project sites of TATA Power Group Companies.

3. **EXPECTED RESULTS:**

   3.1. Manage activities/jobs associated with ELCB safely.

   3.2. Control of incidents related to failure of ELCB.

   3.3. Compliance to Regulatory requirements to make work place safety

4. **ACCOUNTABILITY & RESPONSIBILITY:**

   4.1. ACCOUNTABILITY: Concerned Division's Heads / Assets Custodian

   4.2. RESPONSIBILITY: Concerned Engineer.

5. **GLOSSARY/ DEFINITIONS:**

   Shall: mandatory requirement

   Should: Optional requirement

   Earth Leakage Circuit Breaker (ELCB): An Earth Leakage Circuit Breaker (ELCB) is a safety device used in electrical installations with high earth impedance to prevent shock. It detects small stray voltages/differential current and interrupts the circuit if a dangerous voltage is detected. ELCB is also known as RCCB.

   RCCB: Residual Current Circuit Breaker

   JSA: Job Safety Analysis

   LOTO: Lock Out Tag Out

   PPE: Personal Protective Equipment

   PTW: Permit To Work

   Work Permit - The written or printed document that is issued to control working in operational area/ in vicinity of electrical equipments.

Work supervisor - A person who is authorized; to verify that all conditions for working have been met, to define ongoing precautions to maintain safe working conditions during the work, to authorize the work to occur, and to cancel the permit allowing the work; also known as proprietor, work group supervisor, or authorizing person.

Licensed Electrician : PWD Electrical license Holder.

6. PROCEDURES :

Power system protection plays important role for the safety of humans and electrical equipment in Plants and buildings. Earth leakage circuit breaker (ELCB) is an important protection device especially for plants, houses, buildings and Portable Electrical Equipment. The ELCB's spring trap will trip to isolate the fault from the system when line to ground fault occurs. So the healthy condition of the ELCB is very important for safety of human beings and protection of the system.

6.1. Any power supply provided for the use of portable electrical tools shall be given through portable power supply board fitted with ELCB of 30 miliAmp rating.

6.2. If tripping timing exceeds more than 50 Miliseconds at 30 MiliAmp then ELCB shall be replaced immediately.

6.3. The power supply cable shall be free of any joints.

6.4. Testing Schedule: Following testing schedule shall be followed for ELCBs.-

6.4.1. All fixed type ELCBs installed on switchboards shall be tested Half yearly with the help of ELCB tester as per attached SOP (Appendix C) by the licensed Electrician & record shall be maintained as per attached Appendix A.

6.4.2. All ELCBs installed on portable switchboards, switchboard installed at Temporary sheds, and outside areas (outside buildings) shall be tested quarterly with the help of ELCB tester as per attached SOP (Appendix C) by the licensed Electrician.

6.4.3. Before starting any work ELCB provided / installed for that Electrical Circuit to be tested by pressing Push Button provided on ELCB to confirm ELCB is tripping mechanically.

6.4.4. Defective ELCB shall be replaced immediately with new ELCB.

6.4.5. The ELCB testing & failure record shall be maintained in format given in appendix - B.

7. RECORDS :

7.1 ELCB Testing record to be maintained as per Format for minimum three (03) years as per attached appendix A.

7.2 ELCB failure record to be maintained as per Format for minimum three (03) years as per attached Appendix B.

8. TRAINING & COMMUNICATION

8.1. Training of ELCB procedure shall be covered along with Electrical safety Training.

8.2. Initial Communication to be done through Corporate Communication, Email and subsequently this procedure shall be made available at safety portal at Sangam.

9. VERIFICATION

9.1. Verification of implementation of ELCB Testing shall be done during Safety Audit, Field Safety visit and inspections.

10. EXCEPTION :

Any Exception to this procedure shall only be done as per section 6.3 of Document Control .Procedure (**TPSMS/GSP/DC/014/REV01).**

11. REFERENCES

11.1. Electrical safety procedure.

11.2. Indian Electricity act and Rules

11.3. IS : 12640: 2008

12. REVIEW

Review of this procedure shall be done as and when but not later than once in every three (03) years. Typical Factors like Changes in legislation, Review of Incident Reports, Inspection & Audit findings, Feedback from users, Recommendations in

Incident investigation reports may be inputs for the review and revision of the procedure.

13. ATTACHMENTS/APPENDIX :

Appendix-A - Format for ELCB Testing

Appendix-B - Format for ELCB Failure record

Appendix-C- SOP For Testing ELCB

Appendix-D- Photographs of ELCB Tester.

ELCB/016/FORM/01 **Appendix-A**

Format for ELCB Testing

Date	Sr. No. of ELCB	Location	Type & Make of ELCB	Rating in mA	Trip Time in Seconds	Remarks	Name & Sign.

ELCB/016/FORM/02

Appendix-B

Format for ELCB Failure record

Date	Sr. No. of ELCB	Location	Type & Make of ELCB	Rating in mA	Defect (Mechanical / Electrical)	Remarks	Name & Sign.

Appendix-C

SOP for Testing ELCB

Sr. No.	Particulars of Events	Time	Tick
A	**Testing of ELCB/RCCB by pressing Push Button provided on ELCB/RCCB.**		
01	Inform concerned peoples about the testing of ELCB.		
02	Press Push Button provided on ELCB.		
03	Confirm ELCB has tripped i.e. ELCB is tripping mechanically.		
04	If ELCB does not trip then either AC circuit is defective or ELCB is defective.		
05	Rectify AC circuit if faulty. Replace ELCB if Faulty.		
06	Defective/Faulty ELCB record to be maintained in format given.		
B	**Testing of ELCB/RCCB by using 3 Pin/Plug connected to Testing cord**		
01	While carrying out testing of ELCB , Testing crew will wear following PPEs (1) Safety Shoes (2) Safety Helmet (3) Rubber Hand Gloves.		
02	Confirm all the 3 terminals (Phase, Neutral, Earth) of the cable used for testing are properly connected to healthy 3 pin (5A/10A).		
03	Same way all the 3 terminals (Phase-Line ,Neutral, Earth) are properly connected to the terminals of ELCB Tester. Ref. Fig no. 1 of Attached Annexure D.		
04	Confirm ELCB tester is in Off condition		
05	Keep Range selector switch on ELCB tester at 30 for 30 Milliamps rating of ELCB. Ref. fig. 2 of Attached Annexure D.		
	Insert the 3 Pin inside a plug whose ELCB to be Tested & switch on the Plug/Pin supply. Ref. Fig. 3 of Attached Annexure D.		
06	Switch ON ELCB tester .		
07	If all connections are proper then Voltage & Frequency will appear on the display of ELCB Tester. Ref. Fig. 4 of Attached Annexure D.		
08	If connections are not proper or no earthling is extended to that circuit then N-E lamp on ELCB Tester will glow which means Do not proceed for the Test. (Rectify the circuit & then start the Test) Ref. Fig. 6 of Attached Annexure D.		
09	If N-E lamp is not glowing, voltage is proper on display then start Test by pressing PRESS switch provided on ELCB Tester.		
10	Confirm that desired ELCB has tripped & note down the values from the display of ELCB Tester.		

Sr. No.	Particulars of Events	Time	Tick
11	Tripping timing of ELCB should be 30Miliseconds		
12	If tripping timing exceeds more than 50 Miliseconds at 30 MiliAmp then ELCB shall be replaced immediately.		
13	Defective/Faulty ELCB record to be maintained in format given. Frequent failure analysis to be done.		
C	**Testing of ELCB/RCCB by using Testing cord (No 3 Pin connected to Testing cord)**		
01	While carrying out testing of ELCB, Testing crew will wear following PPEs (1) Safety Shoes (2) Safety Helmet (3) Rubber Hand Gloves.		
02	Confirm ELCB tester is in Off condition		
03	Confirm all the 3 terminals (Phase-Line, Neutral, and Earth) of the cord used for testing are properly connected to ELCB Tester.		
04	In case of 3 Phase ELCB there are 4 points (Holes access to 3 phases & Neutral) on ELCB i.e. R,Y,B,N.		
05	For Testing R phase, insert phase-Line cord coming from ELCB tester inside R phase of ELCB, Neutral to N point of ELCB & Earth to Earth point nearby. Ref. Fig. 5 of Attached Annexure D.		
06	Switch ON ELCB tester.		
07	If all connections are proper then Voltage & Frequency will appear on the display of ELCB Tester.		
08	If connections are not proper or no earthling is extended to that circuit then N-E lamp on ELCB Tester will glow which means Do not proceed for the Test. (Rectify the circuit & then start the Test)		
09	If N-E lamp is not glowing, voltage is proper on display then start Test by pressing PRESS switch provided on ELCB Tester.		
10	Confirm that desired ELCB has tripped & note down the values from the display of ELCB Tester.		
11	Tripping timing of ELCB should be 30 Miliseconds		
12	If tripping timing exceeds more than 50 Miliseconds at 30 MiliAmp then ELCB shall be replaced immediately.		
13	Defective/Faulty ELCB record to be maintained in format given. Frequent failure analysis to be done.		
14	Same way test to be conducted for other Phases.		

Appendix-D

Photographs of ELCB Tester

Fig. 1

Fig 2

Fig. 3

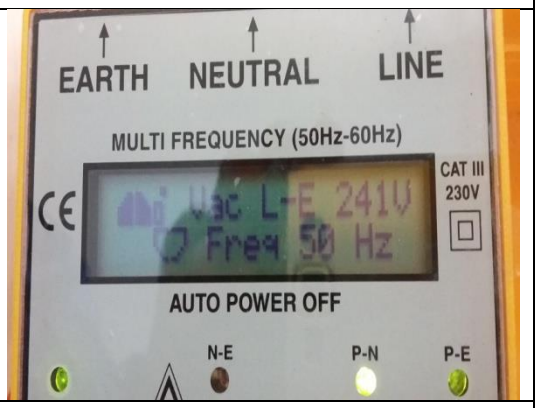

Fig. 4

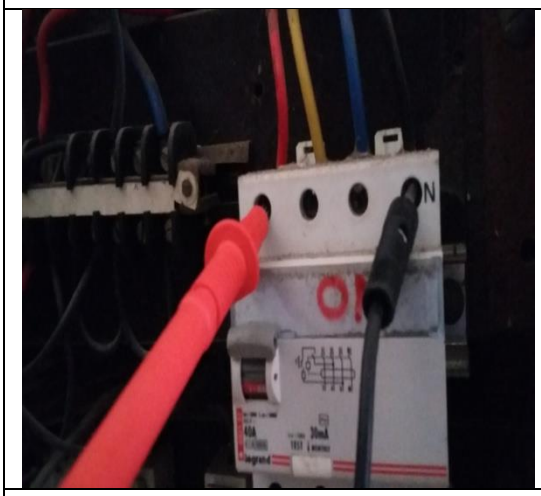

Fig. 5

Fig 6

Hazard Identification and Risk Assessment (HIRA)

Document Control Details

Document Issue	Issue Date	* Compiled By	Document Owner	Approved by
1st		Corp Rules & Procedures - committee	V.Srinavasan	Mr. V.K.Chourey Chairman Corp R&P Committee
Document Revision No.	Revision Date		Document No.	
R-00	Nil			

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* Compiled By -

Location	**Team Members**
Trombay	V.Srinivasan
Trombay	M.P.Mhatre
Trombay	Z.H.Mulani

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1.8 Procedure for Hazard Identification and Risk assessment and Control.
1.9 Records.

1.1 Introduction

Hazard Identification and Risk Assessment (HIRA) The objective of hazard identification is to identify and evaluate the hazards and the unintended events, which could cause an accident. The first task usually is to identify & the hazards that are inherent to the process and/or plant and then focus on the evaluation of the events, which could be associated with hazards. In hazard identification and Quantification of probability of occurrence it is assumed that the plant will perform as designed in the absence of unintended events (component and material failures, human errors, external event, process unknown), which may affect the plant/process behaviour. The primary objective of this process is to provide assurance that new OH&S risks are not introduced or the existing risk profile is not increased without appropriate mitigation. Managing the OH&S impact of changes requires a structured risk evaluation and management framework in accordance with Tata Power HSE Risk Evaluation and management procedures. This shall include, but not be limited to, the development of formal and approved OH&S policies, plans, procedures and standards. However, in the normal course of Tata Power operations there will be a need to update or revise these to reflect changes in operations and/or organisation. Therefore, robust procedures for managing OH&S in changes are essential in order that suitable and sufficient risk controls are maintained and that standards remain up-to-date.

1.2 Purpose: To define guidelines for Hazard identification, Risk assessment and determination of controls.

1.3 Scope: This procedure describes specific techniques to prevent human and property losses in the operation and management of process plant. The overall methodology presented in this procedure allows systematic identification of hazards as well as quantification of the risks associated with the operation of process plants. Applied with due expertise and rigour the prescribed methodology can help the user understand the relative levels of hazards and risk potential in an installation. This aids the selection and prioritization of necessary strategies for accident prevention and limiting their consequences. Therefore, the procedure can be used for improving plant safety performance as well as to reduce human and property losses. Risk analysis is a process that consists of a number of sequential steps as follows:

1.4 Controlling Documents

This document is a specification under Tata Power Document management system.

1.5 Review and Improvement

This specification shall be reviewed, as a minimum, every 3 years. However, Changes to the current version may be made in less than 3 years as required. Users are encouraged to participate in the ongoing improvement of this document by providing constructive feedback to the document custodian.

1.6 Terminology:

For the purpose of this procedure, the following technical terms used are interpreted and understood as given below.

1.6.1 Accident - A specific unplanned event or sequence of events that has undesirable consequences.

1.6.2 Basic Event - A fault tree event that is sufficiently basic that no “further development is necessary.

1.6.3 Consequence - A measure of the expected effects of an incident.

1.6.4 Explosion- A sudden release of energy characterized by accompaniment of a blast wave.

1.6.5 External Event - An event caused by a natural hazard (earthquake, flood, etc) or man-induced events (aircraft crash, -sabotage, etc).

1.6.6 Fire- A process of combustion characterized by heat or smoke or flame or any combination of these.

1.6.7 Frequency - The number of occurrences of an event per unit of time.

1.6.8 Hazard - A characteristic of the system/plant process that represents a potential for an accident causing damage to people, property or the environment.

1.6.9 .Initiating Event - The first event in an event sequence.

1.6.10 Mitigation System - Equipment and/or procedures designed to respond to an accident event sequence by interfering with accident propagation and/or reducing the accident consequence.

1.6.11 Probability - An expression for the likelihood of occurrence of an event or an event sequence during an interval of time or the likelihood of the success or failure of an event on test or on demand.

1.6.12 Risk - A measure of potential economic loss or human injury in terms of the probability of the loss or injury occurring and the magnitude of the loss or injury if it occurs.

1.6.13 Top Event - The unwanted event or incident at the top of a fault tree that is traced downward to more basic failures using logic gates to determine its causes and likelihood.

1.6.14 Worst Case Consequence - A conservative (high) estimate of the consequences of the most severe accident identified.

1.6.15 : Hazard Identification — Identifying sources of process accidents involving release of hazardous material in the atmosphere and the various -ways (that is scenarios) they could occur.

1.6.16:*Consequence Assessment* — Estimating the probable zone of impact of accidents as well as the scale and/or probability of damages with respect to human beings and plant equipment and other structures.

1.7: Roles and Responsibility: Respective Section heads / HODs (Unless otherwise specified).

1.8: Procedure for Hazard Identification and Risk assessment and Control.

1.8.1 The Tata Power Company has established, implemented and maintained a procedure for the ongoing Hazard identification, risk assessment and determination of necessary risk controls. The Procedure for Hazard identification and Risk assessment is defined below.

Procedure for HIRA:

Sl. No.	**Activity details / Procedure**	**Responsibility**
1	The sequence / flow chart of Hazard identification and Risk assessment is as follows. **Classify the work activities → Identify the Hazards → Determine Risks → Determine existing control measures → Assess the Risk considering the probable failures in the existing risk control measures (i.e., Effectiveness of existing risk control measures) → Decide whether the risk is tolerable → Decide the Risk control Plan.**	**----------**
2	**<u>Classification of work activities</u>:** Department Heads in association with the core team member shall list out routine and non-routine activities, activities of all personnel having access to the workplace (including Contractors and Visitors) in the respective department. and gather the following information wherever possible, for each work activity. ▪ Tasks being carried out; their duration and frequency. ▪ Location/s where the work is carried out. ▪ Who normally carries out the tasks. ▪ Others who may be affected by the work (e.g. visitors, contractors, the public) ▪ Training, that personnel have received about the tasks.	HODs/ Section Heads

	▪ Work permit system for the job ▪ Size, shape, surface character of and weight of materials that might be handled. ▪ Utility services such as compressed air/steam. ▪ Substances used or encountered during the work ▪ Physical form of substances used and recommendations as per MSDS. ▪ Legal and other requirements. ▪ Records of accident/s and incident/s and analysis ▪ Communications from employees and other interested parties. ▪ Work place monitoring data. ▪ Control measures believed to be in place. ▪ Safety committee reports Note: Any interested party can request concerned department heads and he/she shall fill up the risk assessment format and the Department Head shall evaluate the same.	
3	Identify hazards and determine risks. Hazard identification and risk assessment to be pro-active rather than reactive. The broad categories of hazards are: a) **Mechanical** (Example: Fall / slip due to slippery floor, Exposure to moving / rotating parts of machine etc) b) **Electrical** (Example: Electric shocks / electrocution) c) **Substances** (Example: Direct contact with acids / chemicals). d) **Fire and explosion.** e) **Radiation** (Example: Exposure to X-rays etc) f) **Toxic release** (Example: Leakage of chlorine, ammonia etc) g) **Natural calamities.(**Earth quake, Floods, h) Severe wind storm, lightening etc) i) **Biological hazards** (Example: Sources of biological hazards include bacteria, viruses, insects, plants, birds, animals, and humans. These sources can cause a variety of health effects ranging from skin irritation and allergies to infections (e.g., tuberculosis, AIDS), cancer and so on.	HODs/ Section Heads
4	The following three questions enable hazard identification. a) Is there a source of harm? b) Who (or what) could be harmed? c) How could harm occur?	HODs/ Section Heads
5	While identifying the hazards and determining the risks, the following factors shall be considered. ▪ Human behavior, capabilities and other human factors. ▪ Hazards originating outside the workplace capable of adversely affecting the health and safety of personnel under the control of the organization within the	HODs/ Section Heads

	workplace. ▪ Hazards created in the vicinity of the workplace by work related activities under the control of the organization. ▪ Infrastructure, equipment and materials at the workplace, whether provided by the organization or others. ▪ Changes or proposed changes in the organization, it's activities and materials. ▪ Modification to the OH&S Management system including temporary changes. ▪ Applicable legal obligations relating to risk assessment and implementation of necessary controls. ▪ Design of workplace, processes installations, machinery / equipment, operating procedures and work organization, including their adaptation to human capabilities.	
6	After identifying the hazards and determination of risks, carrying out risk assessment and classify the risks based on the risk priority number (RPN).	HODs/ Section Heads
7	Hazard identification and Risk assessment shall be reviewed at least once in 6 months to keep this information up-to-date.	HODs/ Section Heads
8	However, Hazard identification and Risk assessment shall be reviewed before implementing changes to the activity / process / equipment / existing risk control measures. Review of Risk assessment shall be carried out during the following situations. ▪ During changes from normal operation, new or modified process/ installation, changes in raw materials, chemicals etc, ▪ During expansion, contraction, restructuring ▪ New or modified legislation. ▪ New information/inputs from interested parties ***Note : Care should be taken to ensure that risk level is not increased due to the introduction of change/ modification to the existing activities, materials , equipments, processes, risk control measures***	HODs/ Section Heads
9	The significant OH&S Risks identified by all departments are reviewed in the Management Review Meeting to identify the OH&S objectives of the organization. In addition to this, the individual departments may identify OH&S objectives in a proactive manner.	HODs
10	**Hierarchy of Risk Control measures:** While determining risk controls or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy: ▪ **ELIMINATE (REMOVE) / SUBSTITUTION** ▪ **ENGINEERING CONTROLS**	HODs

	▪ **SIGNAGE / WARNINGS and / or ADMINISTRATIVE CONTROLS.** ▪ **PERSONAL PROTECTIVE EQUIPMENTS (PPEs - Last resort).** **Examples:** a. **Eliminate / Substitution** → (If practicable, Eliminate the hazards altogether, or combat the risk at source….. For example→ Use a safe substance instead of dangerous one). . **Engineering Controls** → If elimination or Substitution is not possible, try to reduce the risk through engineering controls such as Usage of low voltage electrical appliance, remote operation from enclosure. Other examples for Engineering controls are: (Machine guarding, Proper platforms, Acoustic enclosures, automation instead of manual operations) c. **Administrative controls →** (Work permit systems, Barricading, Limited access, providing training, display of signages etc). d. **PPEs** → If hazard cannot be avoided, protect yourself (Example: Helmets, Safety belts, Goggles, Nose masks, shields, Hand gloves, Gum boots, Safety shoes, Aprons etc).	

1.8.2 RISK ASSESSMENT:

A. QUALITATIVE ASSESSMENT OF RISKS:

a) **LC – Legal Concern**: The hazard or risk is addressed by applicable legal requirements such as Factories Act / State factory rules or Indian electricity rules etc.

b) **IPC – Interested Party Concern**: The hazard / Risk having a concern expressed by Employees, Neighbors, local residents. (Note: The head of the department conducts the risk assessment for any complaint received by any employee or interested party and if he feels that the risk is intolerable then the same is considered as interested party concern and the risk is treated as intolerable. Proper control measures are taken for the to reduce the risk)

c) **BC – Business Concern** : Any hazard and Risk which will result in:

- Fatal accidents / severe damage to human health and safety.
- Damage to property resulting in loss of Production.
- Huge financial implications.

d) E – Potential Emergency situations which result in loss or damage to humans / property / environment.(Emergency : Any situation, arising out of major fire, gas leak, explosion, toxic release, flooding which is likely to go out of control and requires controlling by a pre determined team. The situation may result in injury/ill health to group of employees and/or general public and/or, property damage which require mitigation of losses.

B. **Any Hazard / risk which is associated with a Legal Concern (LC), Interested Party Concern (IPC), Business Concern (BC) and Potential Emergency situations (E) are considered as Significant Risks by default.**

The following Qualitative Risk Assessment matrix will be used across Tata Power for maintaining consistency.

Probability	**Very high** Almost certain, it will occur >80% in any time frame					
	High Expected to occur 10 % to 80 % chance in time frame					
	Medium It could occur less than up to 10 % chance in time frame					
	Low Not expected to occur less than .1 % in time frame					
	Very Low Almost certain it will occur greater than .01% chance in time frame					
		Very Low	Low	Medium	High	Very High
		1	2	3	4	5
		Consequence Severity Increases				
Consequ.	People (Health and Safety)	No Health / Injury risk	Fir4st aid cases or slight health problem	Lost time injury or potential health problem	Partial disability or major health problem	Total disability / fatality (s) server healthy problem

	Environmental	Negligible effect confined to in plant grounds / environment	Minor effects neighbours adjacent to plant complain	Localise rerelease makes local TV coverage / news paper	Major release make national TV coverage / news paper	Massive damage makes international TV coverage / new paper
	Product or Service Quality	Some product or service fails to meet standards	Several costumer complain verbally	Several customer complain in writing	Important / major customer cancelled orders	Loss of substantial marked share due problem
	Assess or finance loss	Slight damage is Up to Rs 10,000	Noticeable damage between Rs 10,000 to 1 Lakh	Large damage 1 Lakh to 10 Lakhs	Major damage 10 Lakhs to 100 Lakhs	Severe damage more than 1 Crore
	Reputation (Local, National, or International	Slight to moderate impact	Loss of community reputation	Loss of state reputation	Loss of national reparation	Loss of international reputation

PPE MANDATE

Document Control Details

Document Issue	Issue Date	* Compiled By	Document Owner	Approved by
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Document Revision No.	Revision Date		Document No.	
R-00	Nil		CS-PGL-015	

User Notes: - Corp Rules and procedure Team at Tata Power, is the custodian of this document and is responsible for the Administration and Authorization of this Policy. Rules and procedure Site Team is responsible for confirming the accuracy and integrity of content and proposed changes to the requirement of PPE

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* Compiled By -

Location	Team Members
Trombay	Mr V Srinivasan
Trombay	Mr P M Naik
Engineering dept	Mr A S Kakirde
Trombay	Mr C G H Aranha

Scope:

The scope of this policy shall be applicable for any work related to TATA POWER. The PPE's must be of good quality and appropriate to their work as per relevant IS codes.

Selection of PPE's to be done based on IS / equivalent spec, manufacturer's recommendation and feedback from users. A record of the PPE's identified and chosen for the task, the manufacturers' instructions for the cleaning and storage also to be kept for reference.

POLICY ON MANDATORY USE OF PPE IN COMPANY PREMISES.

(To be followed by all Visitors, Contractors and Tata Power Employees.)

A. General: With the objective of ensuring personal safety and uphold safe practices of the highest order; The Tata Power Company Limited enforces the following policy for all persons, who enter the company premises, operating plants or project sites. Violations of the policy shall call for action as per "The Consequence Management policy" of the company, in force at that time. The entire premises shall be subdivided into areas depending on the PPE mandate applicable to that area and these areas shall be demarcated with required number of entrances. All the entrants to the Tata Power premises, except for the categories (a) and (b) in section D as mentioned below, shall also strictly ensure not to wear loose clothing in the operations / project sites.

B. Division of the premises: For the purpose of this policy the entire premises shall be divided as:-

1. Office area, including Canteen, Restrooms, Changing rooms etc;
2. Internal and peripheral roads not within plant battery limits; open spaces (like safe assembly areas, parking lots, gardens etc.).
3. Plant areas including roads within the battery limits.

C. A few examples of the PPE requirements are given below (Not an exhaustive list)

Sr. No	Area	PPE required
1	Plant Area - TG deck feed cycle, boiler fan area etc	Safety Shoes, Helmet, hand gloves, ear plugs / muffs and goggles.
2	Materials and Fuel Area	Safety Shoes, Hand Gloves, Helmets, goggles
3	Parking lots, open areas, peripheral and internal roads and safe assembly areas.	Safety Shoes
4	Plant Area - Chemical handling	Safety Shoes, Helmet, hand gloves, canister type mask with suitable filters, goggles, face shield and any other job specific PPE

D. Mandate for different Categories of entrants:

a) For office staff: The office staff can be in their usual outfit. The office staff shall normally enter the premises from the authorized main gate. They shall walk to, or take a shuttle bus to travel to the office building by the shortest route, using the PPE free walk way. No PPE mandate shall be applicable for these walk ways. In case required to go out to any other area, except the safe assembly area at times of emergency, they shall obey the PPE mandate for that area.

2…

b) Vendors, visitors stakeholders and others, supposed to have some work in the office building only: As in (a) above.

c) Technical staff: This includes operation, maintenance staff and all those regularly required to enter the plant premises as a part of their routine job. They shall carry with them all the PPEs required for that particular area / job and use the same judiciously.

d) External experts: Those who are not conditioned and acquainted with our safety policies shall be accompanied by the authorized representative of the originating department. Experts coming for long assignment, when conditioned and acquainted with our safety policies, can work without being accompanied by a Tata Power representative. The originating department engineer calling the external expert for work in the company premises shall be responsible for conditioning and acquainting the external experts with our safety policies as well as job specific PPE requirements.

The PPE mandate applicable for different areas in their control will be decided by the Plant / SBU head. The mandate shall be clearly, prominently and distinctly displayed at all the entrances to the areas within the premises in bold sign boards so as to catch unfailing attention of any entrant to the area as far as possible. As far as possible the boards shall be similar in size, shape at all the locations of the company to maintain identity. SBU head may make some site specific changes, if so required.

Certain areas where the company employees, particularly those who are in O&M wish to take rest or relax must be condoned off as ‘No PPE” area and be suitably covered, well ventilated and out of any apparent danger of the type that the PPEs can prevent. Once the employee is out of this area, he must again put on his PPEs as required.

****

Projects Access Control Philosophy

A. Background:

The Apex Safety Committee (ASC) during its meeting on 02.06.2011, made a strong recommendation to improve Access control in project sites for safety (Ref.: 12.01.04). A Special Task force was formed to analyze and suggest practical solutions.

The Task force had a special brainstorming session on 17.06.2011, debated various practical options and has finally come out with the following philosophy.

B. Objectives:

To classify project personnel under broader categories based on the safety critical jobs in which they are involved; identify the helmet stickers for each category for ease of identification and control.

To divide the project areas into various zones in order to install physical barricades (fence etc) and influence proper access control;

C. Categories of project personnel involved in safety critical jobs:

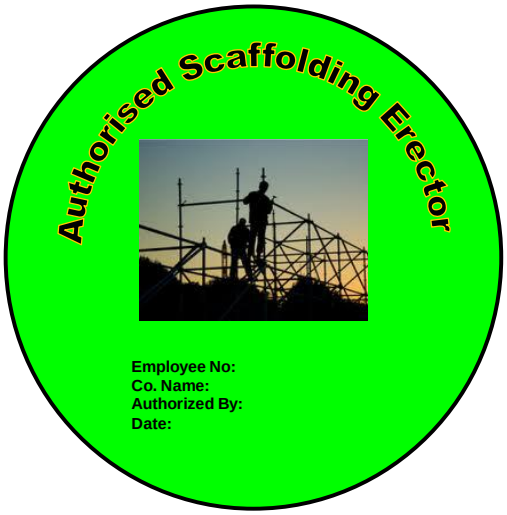
S.N	Categories of personnel involved in Top 8 Safety critical jobs	Authorization by	Prerequisites for authorization
1	Personnel working at height	Head-Mech Head-Civil	– Medical report – General safety induction – Working at height training and Test (includes knowledge of precautions, care for self, fellow colleagues, PPE for safe working at height)
2	Scaffolding erectors	Head-Mech	– Medical report – General safety induction – Scaffolding erector training
3	Riggers & Signal men	Head-Mech	– Medical report – General safety induction – Safe rigging and signal practices
4	Heavy Equipment Operators (including cranes, JCBs, Hydras, Shovel loaders, and winch operators)	Head-Mech	– Medical report – Driving license – General safety induction – Material handling – Safe rigging and signal practices
5	Electricians	Head-Elect	– General safety induction – Govt. Electrical license (as applicable) – Electrical safety training
6	Welders and gas cutters	Head-Mech	– General safety induction – Welding and gas cutting safety
7	Gang leaders	Concerned HODs	– General safety induction – Supervision for safety course – Job Safety Analysis (JSA) – Permit to work (PTW)

			– Electrical safety training – Gas cylinders safety – Safety inspection and auditing
8	Personnel working for deep excavation	Head-Civil	– Medical report – General safety induction – Excavation Safety Training – Confined Space Entry Training

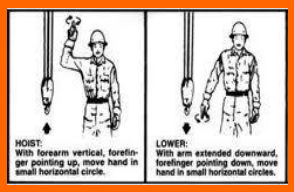
D. Method of Control to prohibit unauthorized engagement in safety critical jobs:

The distinct helmet stickers will be issued as per the below samples to control unauthorized personnel being deployed in safety critical jobs.

Authorised to work at Height
Employee No:
Co. Name:
Authorized By:
Date:


Authorised Scaffolding Erector
Employee No:
Co. Name:
Authorized By:
Date:

Authorised Rigger & Signal man



Employee No:
Co. Name:
Authorized By:
Date:

Authorised Heavy Equipment Operator

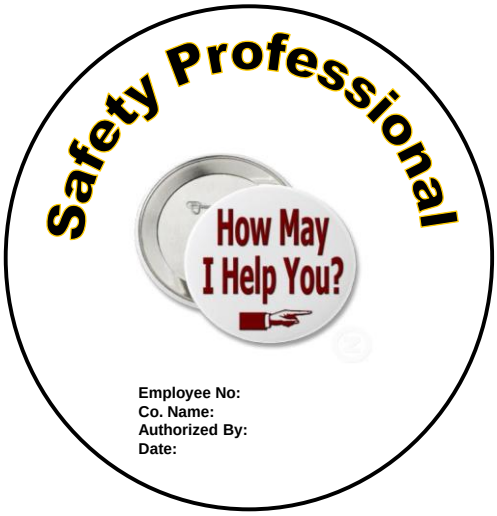
Employee No:
Co. Name:
Category:
Authorized By:
Date:

Authorised Electrician
Danger
Electric shock risk
Employee No:
Co. Name:
Category (LV/HV) :
Authorized By:
Date:

Authorised Welder/Gas Cutter
Employee No:
Co. Name
Authorized By:
Date:

Authorised Gangleader
Employee No:
Co. Name
Authorized By:
Date:

Authorised To Work for Deep Excavation
Employee No:
Co. Name:
Authorized By:
Date:



E. Project Zonal classification:

S.N	Zones	Color Stickers
1	Boiler & ESP	Violet
2	Turbine Generator (TG)	Blue
3	Balance of Plant (BOP)	Green
4	Chimney	Yellow
5	Switch yard	Orange
6	Internal Coal Handling System (ICHS)	Red
7	Administrative Offices	NIL

F. Method of control to prohibit unauthorized entry into sensitive areas:

Different color stickers will be affixed on helmet to indicate the area(s) for which an individual is authorized to work.

SECTION D- TATA POWER STANDARD POLICIES

HEALTH AND SAFETY POLICY

We, at Tata Power, reaffirm our belief that the health and safety of our stakeholders is of the utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- Maintain and proactively improve our management systems to minimize health and safety hazards to our stakeholders and all others influenced by our activities.
- Comply and endeavour to exceed all applicable occupational health & safety legal and other requirements by setting the highest standards.
- Integrate health & safety procedures and best practices into every operational activity with assigned line-functional responsibilities at all levels, for improving and sustaining health & safety performance.
- Involve our employees in maintaining a safe and healthy work environment through risk assessments, periodic reviews of operational procedures, safe work methods and adoption of new technology.
- Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees developing their skills to work safely.
- Incorporate appropriate health & safety criteria into business decisions for selection of plant and technology, performance appraisal of individuals and appointments in key positions.
- Ensure availability at all times of appropriate resources to fully implement the health & safety policy of the company.
- Promptly report incidents, investigate for root causes and ensure lessons learnt shared and deployed across the company.
- Ensure service providers and their workmen align with company's safety codes and practices for the health and safety of personnel working with us.
- Set safety & health metrics as indicators of excellence, monitor progress and continually improve performance.

We shall actively communicate this policy to all stakeholders by suitable means and periodically review its relevance in continuously changing business environment.

(Praveer Sinha)
CEO & Managing Director

Date: 15th June, 2018

TATA POWER

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CORPORATE ENVIRONMENT POLICY

Tata Power is committed to a clean, safe and healthy environment, and we shall operate our facilities in an environmentally sensitive and responsible manner. Our commitment to environmental protection and stewardship will be achieved by:

- Complying with the requirements and spirit of applicable environmental laws and striving to exceed required levels of compliance wherever feasible
- Ensuring that our employees are trained to acquire the necessary skills to meet environmental standards
- Conserving natural resources by improving efficiency and reducing wastage
- Making business decisions that aim towards sustainable development
- Engaging with stakeholders to create awareness on sustainability

Date: 15th June, 2018

(Praveer Sinha)
CEO & Managing Director

TATA POWER
Lighting up Lives!

CORPORATE SUSTAINABILITY POLICY

At Tata Power, our Sustainability Policy integrates economic progress, social responsibility and environmental concerns with the objective of improving quality of life. We believe in integrating our business values and operations to meet the expectations of our customers, employees, partners, investors, communities and public at large

- We will uphold the values of honesty, partnership and fairness in our relationship with stakeholders
- We shall provide and maintain a clean, healthy and safe working environment for employees, customers, partners and the community
- We will strive to consistently enhance our value proposition to the customers and adhere to our promised standards of service delivery
- We will respect the universal declaration of human rights, International Labour Organization's fundamental conventions on core labour standards and operate as an equal opportunities employer
- We shall encourage and support our partners to adopt responsible business policies, Business Ethics and our Code of Conduct Standards
- We will continue to serve our communities:
    - By implementing sustainable Community Development Programmes including through public/private partnerships in and around our area of operations
    - By constantly protecting ecology, maintaining and renewing bio-diversity and wherever necessary conserving and protecting wild life, particularly endangered species
    - By encouraging our employees to serve communities by volunteering and by sharing their skills and expertise
    - By striving to deploy sustainable technologies and processes in all our operations and use scarce natural resources efficiently in our facilities
    - We will also help communities that are affected by natural calamities or untoward incidence, or that are physically challenged in line with the Tata Group's efforts

The management will commit all the necessary resources required to meet the goals of Corporate Sustainability.

(Praveer Sinha)
CEO & Managing Director

Date: 15th June, 2018

TATA POWER
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TATA POWER

For Reference- User Manual e-Bidding & Auction (Ariba)

CONFIDENTIAL

SUPPLIER MANUAL ANSWERING

TO

E-BIDDING

	Version 1.2
Company Confidential	DEC - 2020

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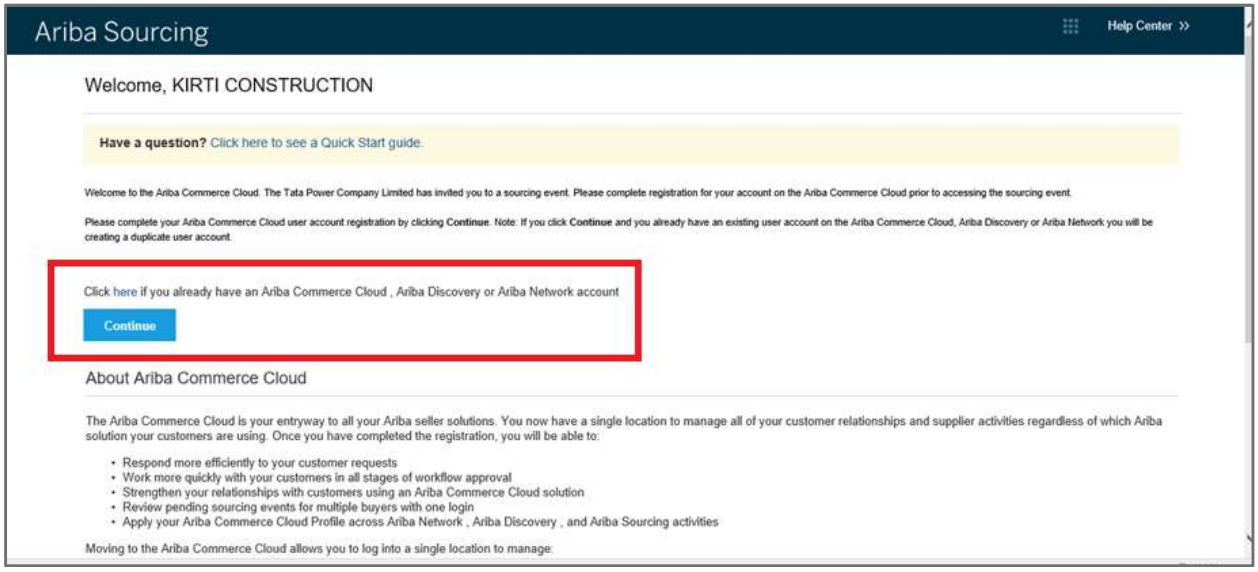
5 SUPPLIER FREQUENTLY ASKED QUESTION 11

1- Accessing Ariba Sourcing

Step 1: You will get an invitation to your email from Ariba System. Keep this email, it contains your login Information and a direct link to Ariba.

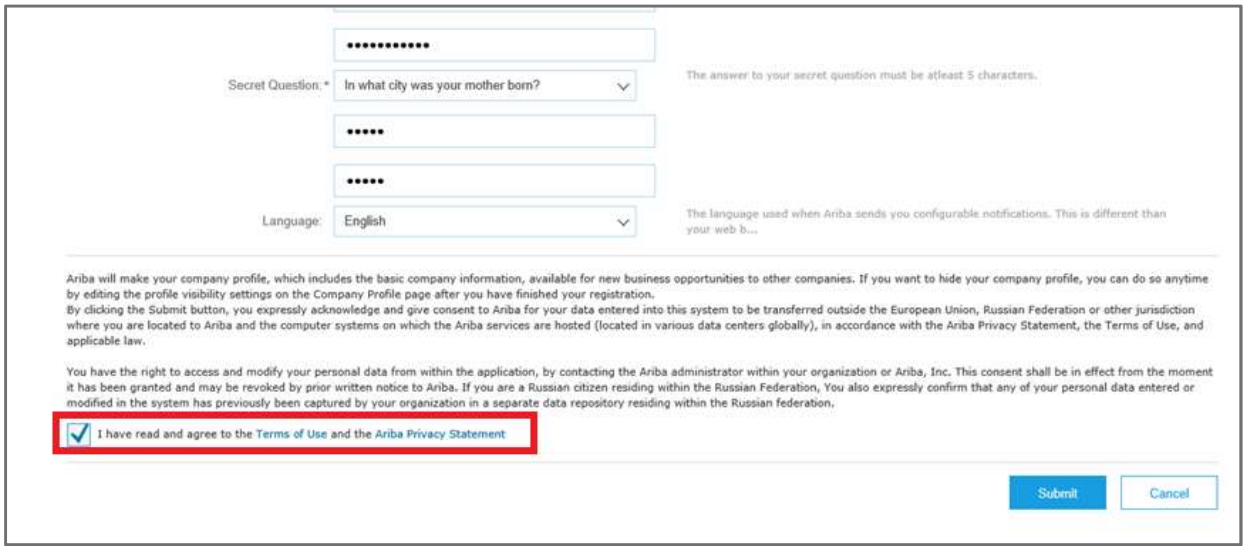
Step 2: Click “Click Here” to access the Ariba Web Site.

Step 3: Supplier has to click on "Continue"



Step 4: The registration process only takes a few moments, with a simple one-page registration Define your password and secret question. Click “OK”

Step 5: If it's the first time you are invited to use UPM Ariba, you'll need to accept the "Participant Terms". Select "I accept the terms of this agreement". Click "Submit".

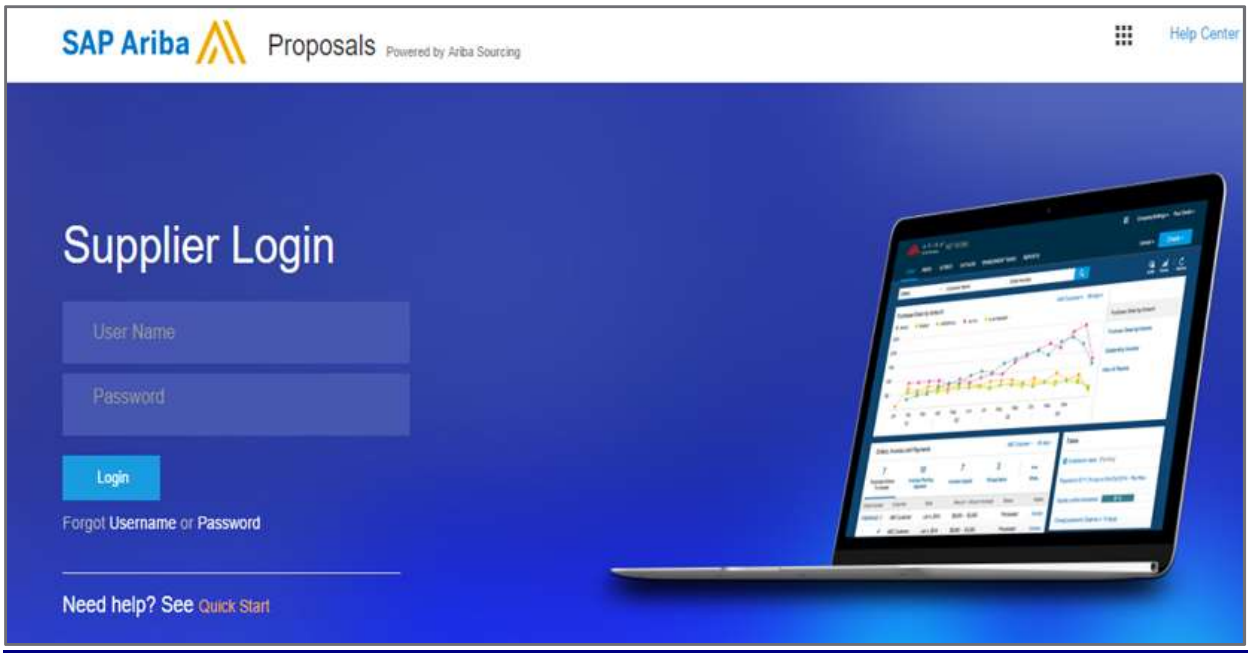


2 Vendor Screen - Submitting Your Answers / Proposal

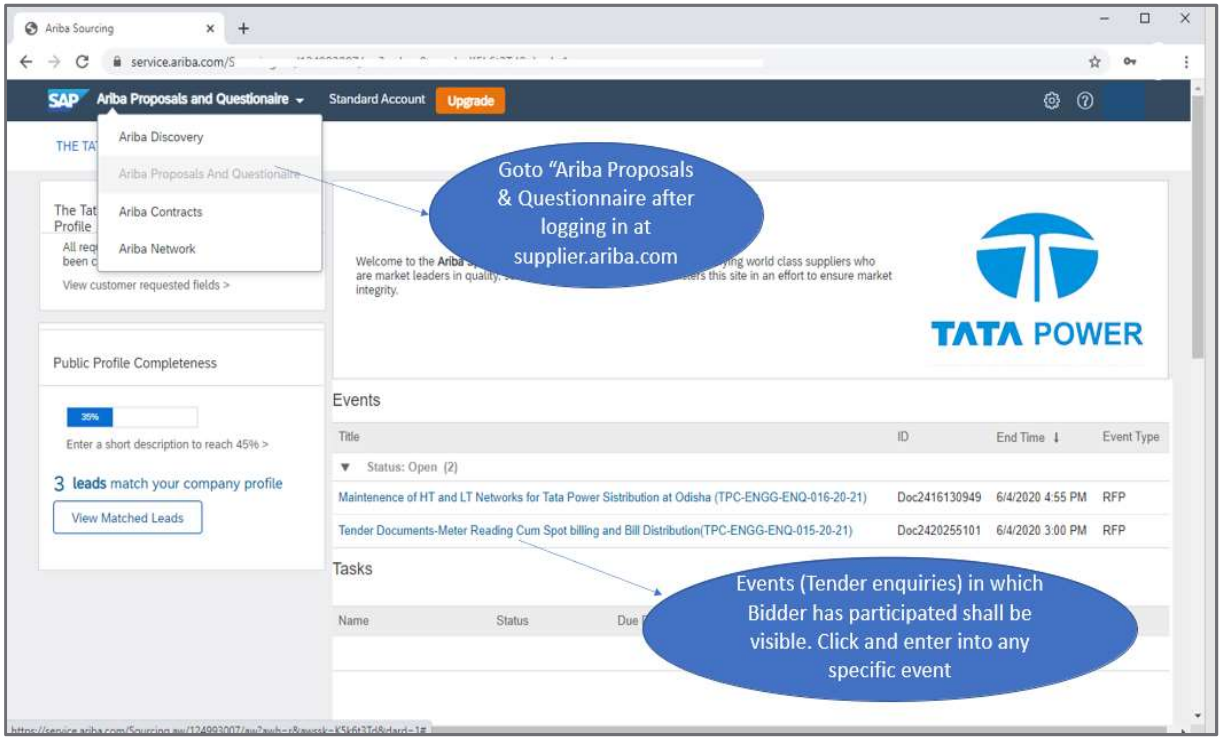
2.1.1 If vendor goes through mail invitation then directly Screen 3.1.1 will appear, but if If you have used Ariba before and have already accessed an event for the buyer-specific account with your current log in ID, click the **Login** button to continue. Log in with your Ariba username and password in order to participate in the event OR you have to follow the following steps.

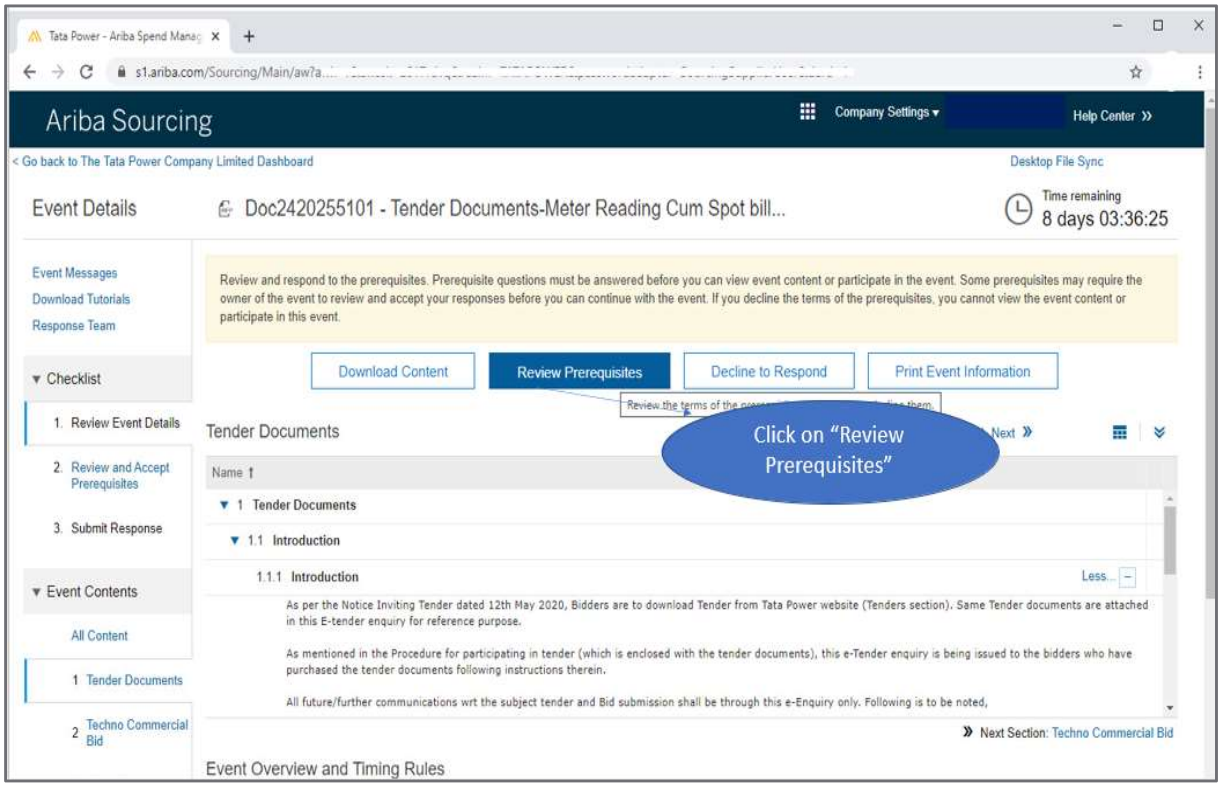
Step 1 - Log on **supplier.ariba.com**

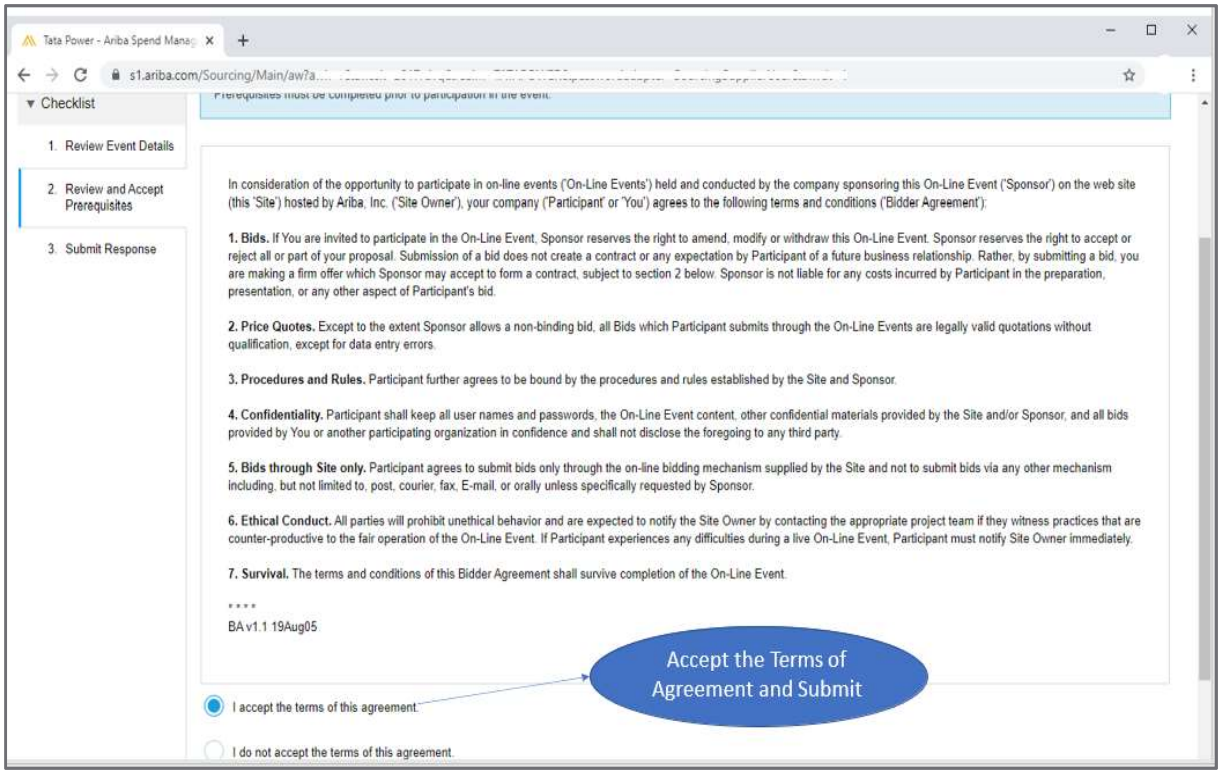
Step 2 - Put your USER ID and Password in following screen



Step 3 - Go to “Ariba Proposals & Questionnaire”.






Tata Power - Ariba Spend Manag
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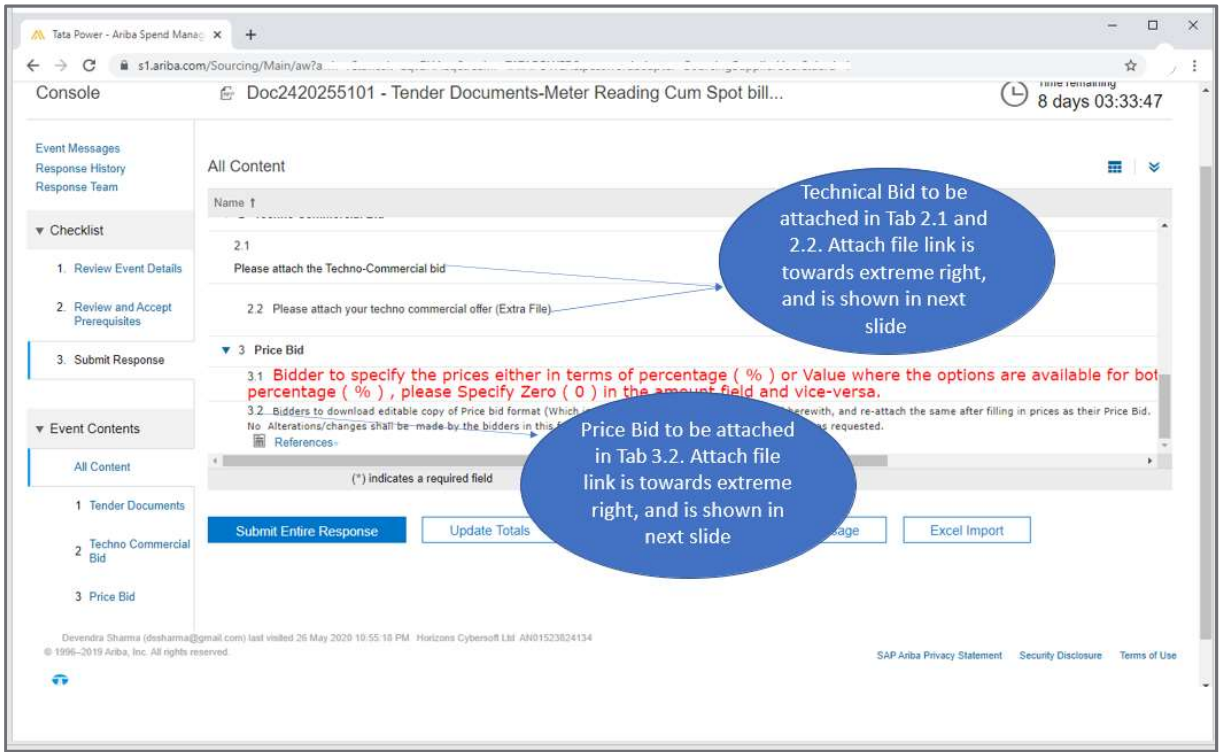
Checklist
1. Review Event Details
2. Review and Accept Prerequisites
3. Submit Response
In consideration of the opportunity to participate in on-line events ('On-Line Events') held and conducted by the company sponsoring this On-Line Event ('Sponsor') on the web site (this 'Site') hosted by Ariba, Inc. ('Site Owner'), your company ('Participant' or 'You') agrees to the following terms and conditions ('Bidder Agreement'):
1. Bids. If You are invited to participate in the On-Line Event, Sponsor reserves the right to amend, modify or withdraw this On-Line Event. Sponsor reserves the right to accept or reject all or part of your proposal. Submission of a bid does not create a contract or any expectation by Participant of a future business relationship. Rather, by submitting a bid, you are making a firm offer which Sponsor may accept to form a contract, subject to section 2 below. Sponsor is not liable for any costs incurred by Participant in the preparation, presentation, or any other aspect of Participant's bid.
2. Price Quotes. Except to the extent Sponsor allows a non-binding bid, all Bids which Participant submits through the On-Line Events are legally valid quotations without qualification, except for data entry errors.
3. Procedures and Rules. Participant further agrees to be bound by the procedures and rules established by the Site and Sponsor.
4. Confidentiality. Participant shall keep all user names and passwords, the On-Line Event content, other confidential materials provided by the Site and/or Sponsor, and all bids provided by You or another participating organization in confidence and shall not disclose the foregoing to any third party.
5. Bids through Site only. Participant agrees to submit bids only through the on-line bidding mechanism supplied by the Site and not to submit bids via any other mechanism including, but not limited to, post, courier, fax, E-mail, or orally unless specifically requested by Sponsor.
6. Ethical Conduct. All parties will prohibit unethical behavior and are expected to notify the Site Owner by contacting the appropriate project team if they witness practices that are counter-productive to the fair operation of the On-Line Event. If Participant experiences any difficulties during a live On-Line Event, Participant must notify Site Owner immediately.
7. Survival. The terms and conditions of this Bidder Agreement shall survive completion of the On-Line Event.
****
BA v1.1 19Aug05
I accept the terms of this agreement.
I do not accept the terms of this agreement.
Accept the Terms of Agreement and Submit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Console
Doc2420255101 - Tender Documents-Meter Reading Cum Spot bill...
8 days 03:33:47
Event Messages
Response History
Response Team
Checklist
1. Review Event Details
2. Review and Accept Prerequisites
3. Submit Response
Event Contents
All Content
1 Tender Documents
2 Techno Commercial Bid
3 Price Bid
All Content
Name
2.1
Please attach the Techno-Commercial bid
2.2 Please attach your techno commercial offer (Extra File)
3 Price Bid
3.1 Bidder to specify the prices either in terms of percentage (%) or Value where the options are available for bot
percentage (%) , please Specify Zero (0) in the amount field and vice-versa.
3.2...Bidders to download editable copy of Price bid format (Which
No Alterations/changes shall be made by the bidders in this
References
(*) indicates a required field
Submit Entire Response
Update Totals
Excel Import
Technical Bid to be attached in Tab 2.1 and 2.2. Attach file link is towards extreme right, and is shown in next slide
Price Bid to be attached in Tab 3.2. Attach file link is towards extreme right, and is shown in next slide
Devendra Sharma (desharma@gmail.com) last visited 26 May 2020 10:55:18 PM Horizons Cybersoft Ltd AN01523824134
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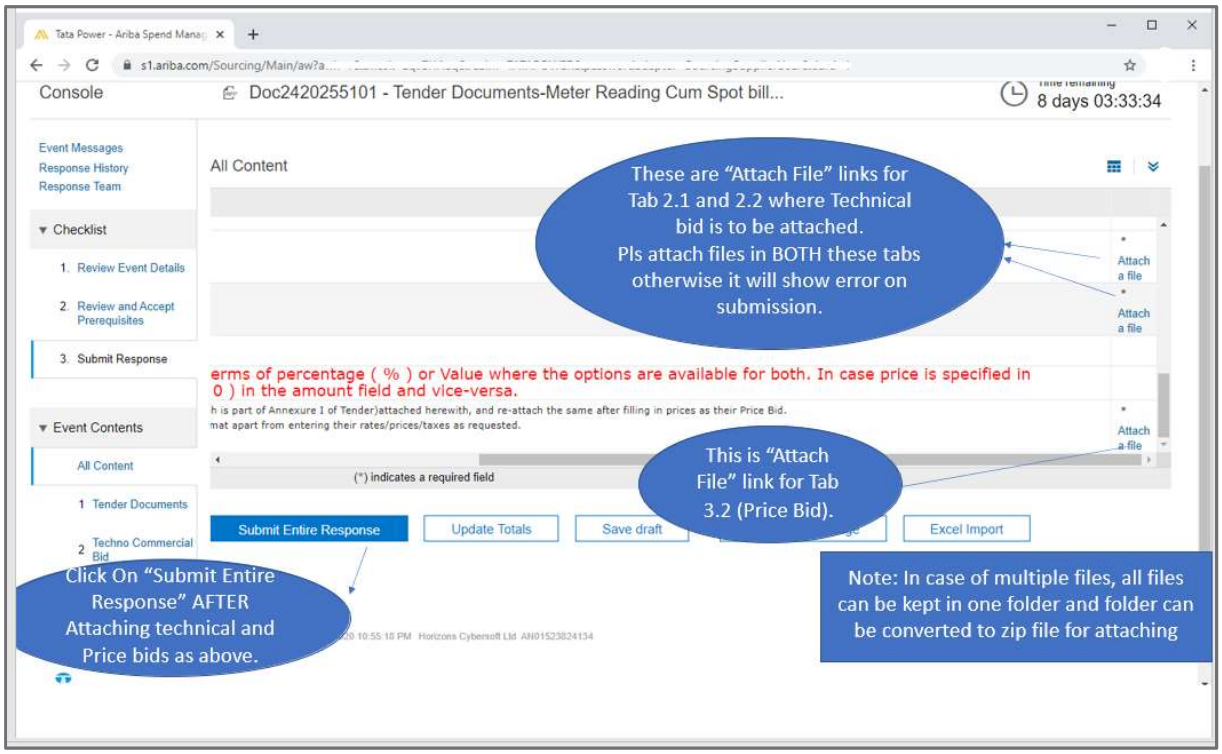
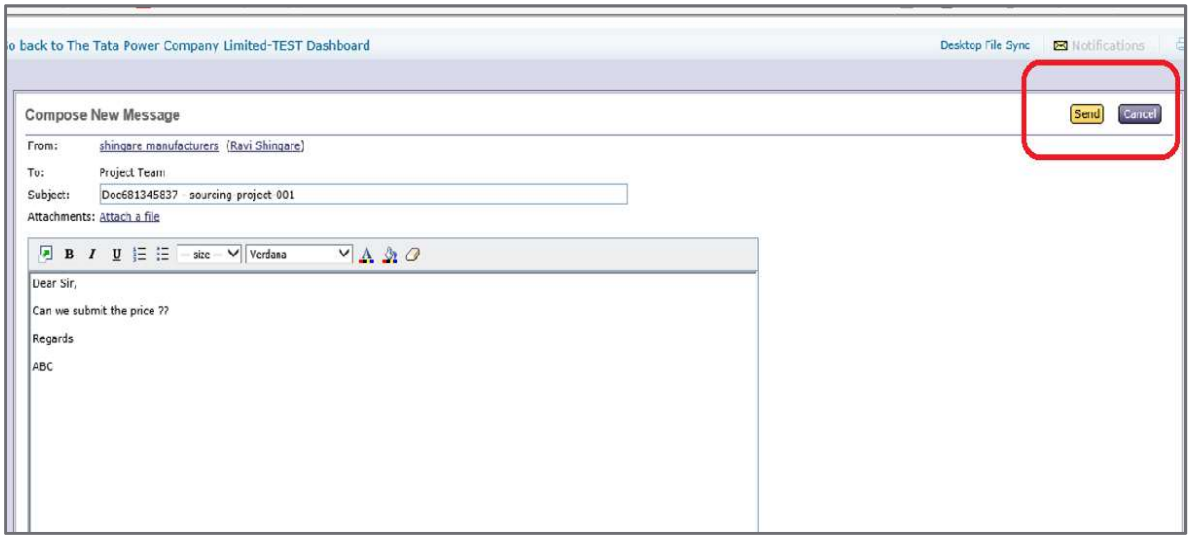


3 Communicating with Tata Power Buyer during e- bidding

Step 1: Click "Compose Message".

Step 2: Compose Your Message and click "Send".



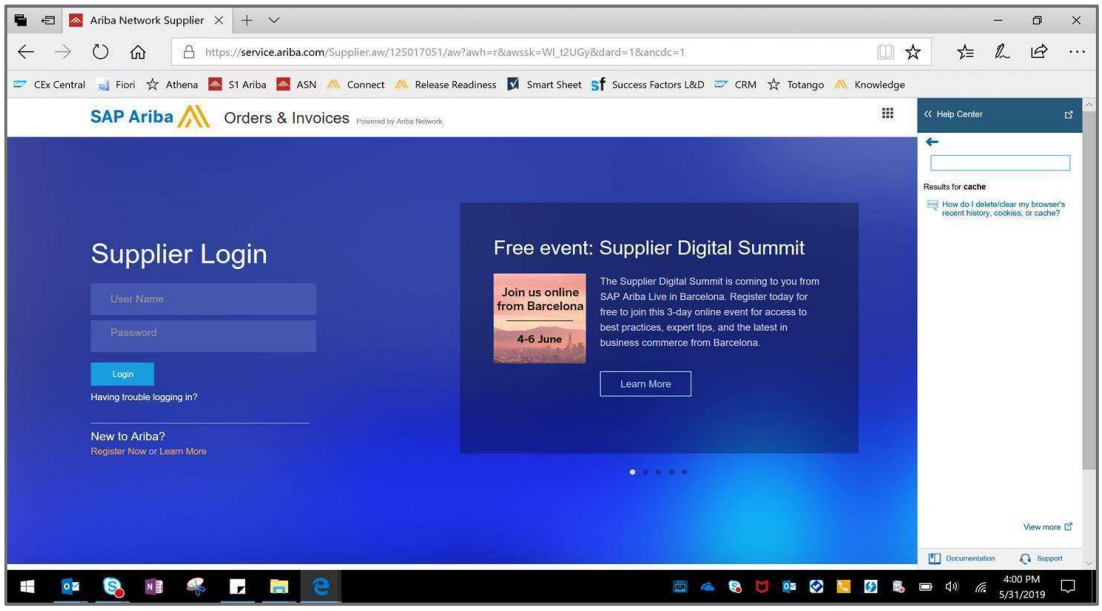
ARIBA TRAINING VIDEOS

Participating in a RFI or RFP on Ariba Network - https://www.youtube.com/watch?v=9_XXUaVyI7o

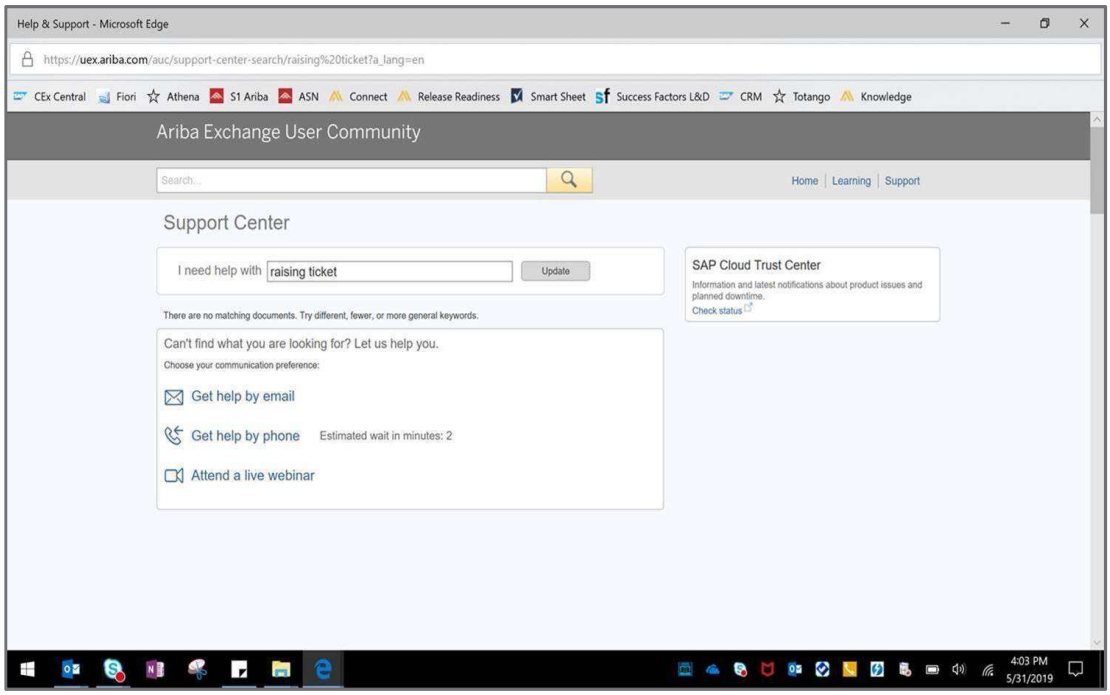
Support from Ariba - Supplier can raise the Ticket for "Support"

Here are the steps that Suppliers can follow for raising a ticket or requesting a call back from Support team. They can do so without logging in – pls follow the brief instructions given below.

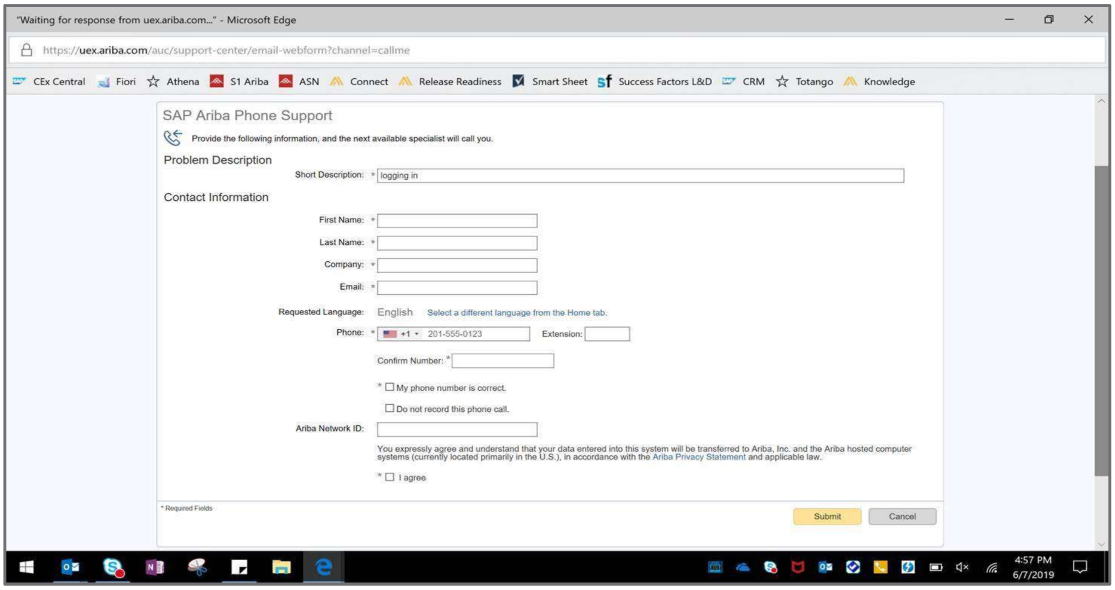
1. Go to login page>Choose "Support" on the bottom right corner



2. Add query and press "Start" – After that, following screen will pop up where you can choose either Get Help by Email or Get Help by Phone.



3. Choose phone and add following basic details and you will get call back



If not by phone, they can ask for a response/support by email.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

SUPPLIER FREQUENTLY ASKED QUESTIONS

- **If I registered on my buyer's Ariba Sourcing site in the past, do I need to register again?**

Answer- Yes. Although you have registered on your buyer's Ariba Sourcing site in the past, registering on the Ariba Commerce Cloud is required. The registration process only takes a few moments, with a simple one-page registration. Registering on the Ariba Commerce Cloud gives you access to all your buyer relationships with one username and password.

- **What is the Ariba Commerce Cloud?**

Answer: - The Ariba Commerce Cloud is your entry point to all of your seller solutions.
Rather than managing log in information for multiple buyers' sites, you will have one log in and one account. This means fewer passwords to remember, easier user maintenance for your company, and a unified profile for your organization.

- **Do I need to add Product and Service Categories during registration?**

Answer:-Yes; this is a required field. Product and Service Categories classify what your company sells, and the system uses this information to match potential business opportunities with your products and services.

Click **Add Product and Service Categories** to select one or more categories from the list of options. During registration, you only need to choose one category, preferably related to the event you are joining. You can add, refine, or remove categories any time after the registration process.

- **Do I need to add ship-to or service locations during registration?**

Answer: - Yes; this is a required field. Ship-to or Service locations inform buyers where your company sells its products or provides its services, and the system uses this information to match potential business opportunities with your products and services.

Click **Add Ship-to or Service Locations** to select one or more sales territories from a list. You can add, refine, or remove ship-to or service locations any time after the registration process.

Additional Information: - D-U-N-S is a registered trademark of Dun & Bradstreet or its subsidiaries in the United States and other countries.

- **What is the difference between the Email and Username fields in my profile?**

Answer: - The Email field represents the email address where you wish to receive email notifications. The Username field is the identifier that you use to access your account. The Username field must be in email format, but you do not have to use a valid email address.

Note: Leave the **This is my username** box checked if you want your email address to be the same as your username.

- **How do I participate in my buyer's event using an email invitation?**

Answer: - Use the **Click here** link in the email notification to access the sourcing event.

While buyers might customize the email content you receive, all email invitations contain a link to access the event.

Depending on your previous experience with Ariba solutions, do one of the following to access the event after you click the link:

- If you are new user, click **Continue** on the welcome page. You continue to register an Ariba account to link with your buyer and participate in the event.
- If you have used Ariba before and have already accessed an event for the buyer-specific account with your current log in ID, click the **Login** button to continue. Log in with your Ariba username and password in order to participate in the event.
- If you already have an existing Ariba Network, Ariba Discovery, or Ariba Sourcing supplier account, but you have not accessed any events for the inviting buyer's site, use the **Click here if you already have an Ariba Commerce Cloud, Ariba Discovery or Ariba Network account** link. After clicking the link, log in with your existing account to move your information to your buyer's site.

Additional Information:- Registering an Ariba account provides you with a consolidated view of all your customer relationships. With this one profile, you can view business opportunities, participate in sourcing events, participate in contract negotiations, and manage orders, catalogs, and invoices.

- **Why doesn't the link in the email invitation to participate in a sourcing event work?**

Answer:-If you cannot click the link, or the link does not open the log in page, highlight and copy the Uniform Resource Locator (URL), and then paste the URL into your web browser.

- **Can my company have multiple accounts?**

Answer:-Your Company can have multiple Ariba accounts, depending on your business needs. For example, if your company has several locations around the world, you might want a separate account for each region.

Most companies choose to have one account with multiple customer relationships, which provides a centralized location to maintain their company profile information and all of their customer relationships.

- **How do I complete registration if my username already exists?**

Answer: - This message means that you already have an Ariba Network, Ariba Discovery, or Ariba Sourcing supplier account registered under username you entered. You can either register ua new account by creating a new username, or access one of the following sites to request a password reset for the registered username:

- Ariba Network (This login page is used for all Ariba Network, Ariba Sourcing, or Ariba Contracts suppliers).
- Ariba Discovery login page

To reset your password, click the **Having trouble logging in?** Link on the Login page.

- **Nothing happens when I click Forgot Username and enter my email address**

Issue: - Nothing happens when I click the **Forgot Username** link and enter my email address.

Cause: - After you submit your request to retrieve your username, the Ariba Network sends an email notification with usernames that match the email address you submitted.

Some possible reasons why you may not receive this username retrieval email notification:

- The email address on your account does not match the email address you entered when submitting the request.
- Your buyer-specific account was deactivated before you could move it to the Ariba Commerce Cloud. Generally, that means you probably have not participated in an event with that buyer for a while.

Solution: -

- To ensure you receive this email notification:
- Make sure you type the email address configured within your account.

If your buyer-specific account has been deactivated, contact your buyer to determine how to proceed.

- **Where is my password reset email?**

Answer: - After you submit your request for a password reset, Ariba sends instructions to the email address associated with your account. If you didn't receive a password reset email, check the following scenarios to troubleshoot.

The username you entered is in the wrong format, or it isn't associated with the email address you are checking.

- Keep in mind, your username is in the format of a full email address, but it can be associated with any email address you entered previously.
- Your username is also case-sensitive.
- To confirm that you are using the correct username and format, return to the Ariba login page, and click the **Having trouble logging in?** link (**Forgot Username** if you're working in Ariba Discovery).
    - Choose **I forgot my username**, and click **Continue**.
    - Enter the email address associated with your account, and click **Submit**.

- You will receive an email that lists the exact format of the username associated with the email you entered.

You entered the correct username, but you still didn't receive the password reset email notification.

- This can occur if the configured email address is different from the account you are checking.
- You might have multiple accounts for your company, so make sure you are attempting to access the correct account.

Your email configuration or company's security settings might also prevent you from receiving the password reset email. To find out, check your junk mail folder or email filter settings to verify that automated emails from Ariba are not blocked from your email account.

Why do I get this message on the SAP Ariba Login page: "The username and password pair you entered was not found"?

Answer: - You entered an incorrect **Username** or **Password**. You might receive this message if you entered a previous **Username** or **Password**. Remember that your **Username** has the format of an email address, and both the **Username** and **Password** are case sensitive.

Click the **Having trouble logging in?** Link on the Login page if you don't remember your log in information.