PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

1. **BHEL Contact (Technical):**
For any **technical clarification**, please contact Mr. Nishant Singh, Dy. Manager (TBEM). Contact No. 0120 0674 8515; e-mail: nishant.singh@bhel.in

2. **BHEL Contact (Commercial):**
For any **commercial clarification**, please contact Mr. Sandeep, Dy. Manager (TBMM). Contact No. 0120-6748540; e-mail: kumar.sandeep@bhel.in

3. **Terms of Payment:**
[A] Payment for Main Supply –Circuit Breaker

i) 95% of payment along with 100% GST & F&I shall be made within 45 days for MSE (Micro & Small Enterprises) / within 60 days for Medium Enterprises / within 90 days for non MSME suppliers from the date of receipt of complete invoice along with documents in 3 sets (original + 2 copies) as follows:

- LR / GR duly endorsed by BHEL Site Official.
- CRAC (consignee receipt-cum-acceptance certificate) / MRC
- GST Compliant Tax Invoice
- Packing List (Case-wise)
- Copy of Transit Insurance Certificate from underwriters.
- Material Inspection Clearance Certificate (MICC) issued by BHEL Quality Management
- Guarantee Certificate
- Performance Bank Guarantee (PBG)
-

ii) Balance 05% of payment shall be made within 45 days for MSE (Micro & Small Enterprises) / within 60 days for Medium Enterprises / within 90 days for non MSME suppliers from the date of receipt of complete invoice along with documents in 3 sets (original + 2 copies) as follows:

- Claim Invoice
- Certificate of successful completion of Erection, Testing & Commissioning at Site issued by BHEL Site Official / Construction Management
- Certificate of completion of final documentation as per Purchase Order / Technical Specification issued by BHEL Engineering Management

[B] Payment for Supervision of Erection, Testing & Commissioning (ETC) of circuit breaker at Site
100% of payment shall be made within 45 days for MSE (Micro & Small Enterprises) / within 60 days for Medium Enterprises / within 90 days for non MSME suppliers against certificate of successful completion of Erection, Testing & Commissioning at Site issued by BHEL Site Official / Construction Management from the date of receipt of GST Compliant Tax invoice in 3 sets (original + 2 copies).

Note 01: In-case commissioning is delayed beyond reason not attributable to supplier. Supplier may claim the balance 05% of supply portion after 12 months from the date of last delivery or 12 months from the date of 02.12.2024, whichever is later, upon submission of BG with equivalent amount and the certificate endorsed by BHEL Site In-Charge citing the details that the "delay in commissioning is not attributable to supplier". Further, Vendor has to depute their representative at site for supervision of ETC within 15 days whenever asked.

Note 02:

- Bills shall be submitted to BHEL TBG Noida office for processing along with billing checklist.
- It should be ensured that Tax Invoice complies with statutory requirements under GST law to enable BHEL to avail Input Tax Credit.
- Payment of GST component shall be made only if vendor has deposited the Tax and credit for the same is reflected in GSTN (GST Network).

- Copy of GST Registration Certificate(s) shall be also be attached with Tax Invoice.

4. Terms of Delivery:

Ex-Works basis including P&F (Packing & Forwarding). F&I (Freight & Insurance) up to site is in the scope of bidder. LR / GR date or invoice date (whichever is later) shall be considered as delivery date.

5. Delivery Requirement:

(a) Supply (Main Supply- Circuit Breaker): Within 25 Weeks (175 days) from the date of PO/input by BHEL as per Activity schedule (Annexure-II).

Note: Purchase Order shall be valid for 02 years from the date of placement of purchase order.

Note: In case, BHEL's delivery requirement is not met by vendor(s), then a chance may be given to all such vendors to review their quoted delivery schedule in line with BHEL's delivery requirement. However, if vendor fails to meet the requisite delivery plan, then BHEL reserves the right not to consider the offer of such vendor(s).

6. Prices:

The quoted prices shall be on **Firm basis**. Price to be quoted as inclusive of GST, i.e., Ex-works including Packing & Forwarding Charges + F&I + GST.

Note: Unloading & safe storage at site and transfer of material from storage to erection site shall be under BHEL scope. Bidder to quote prices accordingly.

7. Reverse Auction:

Bid to RA is applicable.

8. Liquidated Damage for delayed Delivery:

If the Seller/Service Provider fails to deliver any or all of the Goods/Services within the original/re-fixed delivery period(s) specified in the contract, the Buyer will be entitled to deduct/recover the Liquidated Damages for the delay, unless covered under Force Majeure conditions aforesaid, @ 0.5% of the contract value of delayed quantity per week or part of the week of delayed period as pre-estimated damages not exceeding 10% of the contract value of delayed quantity without any controversy/dispute of any sort whatsoever.

9. Technical Specification:

Technical Specification Nos. TB-420-316-001-D, Rev00 is applicable. No permissible Technical Deviation has been envisaged. Bidders to quote as per Technical Specifications.

10. Technical Pre-Qualification Requirement:

Technical pre-qualifying requirement shall be as per **Annexure-I.**

11. Manufacturing Quality Plan (MQP):

Inspection shall be carried out as per Customer's approved Quality Plan. For the same, Supplier to submit Quality Plan to BHEL for Customer approval.

12. Inspection & Inspection Charges:

To be inspected by Customer/ BHEL/ TPIA. **Complete inspection cost to be borne by the bidder. For further details, please refer Annexure-X.**

13. Destination/ Delivery Location:

400kV AIS Substation at New Duburi, Odisha

PROJECT	OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)
ITEM	400kV Circuit Breaker
SUBJECT	BID SPECIFIC ATC

14. Guarantee Clause:

The equipment/ material supplied and services rendered (if applicable) shall be guaranteed to be free from all defects and faults in design & engineering, material, workmanship & manufacture and in full conformity with the Purchase Order/ Contract, Technical Specifications & approved drawings/ data sheets, if any, **for 18 months from the date of last delivery or up to 03.12.2028 whichever is later.**

The defective equipment/ material/ component shall be replaced free of cost at site. Freight & Insurance during transit shall also be in the scope of the supplier/ contractor. Any expenditure for dismantling and re-erection of the replaced equipment/ material/ component shall be to supplier's/ contractor's account. All replacements during the guarantee period shall be delivered at site promptly and satisfactorily within a period not more than 45 days from the date of reporting the defect/ rejection, etc.

In the event of the supplier/ contractor failing to replace the defective equipment/ material/ component within the time period mentioned above, BHEL may proceed to undertake the replacement of such defective equipment/ material/ component at the risk and cost of the supplier/ contractor without prejudice to any other rights under the contract and recover the same from PBG/ other dues of this Purchase Order/ Contract or any other Purchase Order/ Contract executed by the supplier/ contractor.

15. Performance Bank Guarantee (PBG):

As per GeM terms and conditions. Performance BG of **05% of GeM contract value** shall submitted be as per BHEL format valid till Guarantee period with claim period of 3 months extra over and above.

Note: Value of the Bank Guarantee (at the time of submission) shall remain unchanged for any subsequent variations in Purchase Order value up to ± 20%. Beyond this variation of ± 20%, the Supplier shall arrange to enhance or may reduce the value of the Bank Guarantee accordingly for the total variation promptly.

16. Acceptance of Offer:

Bidder's offer will be considered for evaluation based on PQR, Technical and other commercial documents submitted along with bid.

Bidder's offer will be acceptable subject to final acceptance of vendor by ultimate customer (OPTCL) as approved supplier. Bidder is required to submit the following documents for vendor approval along with Bid. Failing to submit below documents bidder is liable for rejection:

(a) Company Profile
(b) Performance Certificate
(c) Supply Experience
(d) ISO Certificate
(e) Audited Balance Sheets (latest 3 Years)
(f) Any other document if required

Please note that this is not exhaustive list of documents. Additional documents apart from above can be demanded for arranging customer approval.

17. Make in India:

For this procurement, the local content to categorize a supplier as Class-I local supplier/ Class-II local supplier/ Non-local supplier and purchase preference to Class-I local supplier, is as defined in Public Procurement (Preference to Make in India), Order 2017 Dtd. 04.06.2020, issued by DPIIT. In case of subsequent orders issued by the nodal ministry, changing the definition of local content for the items of the NIT, the same shall be applicable even if issued after issue of this NIT but before opening of part-II bids against this NIT.

"Bidder to specify the percentage of local content as per the format of self-declaration for local content" as per **Annexure-V.**

"This tender is not a global tender and only Class-I suppliers as defined under the DPIIT Order No. P-45021/2/2017-PP (BE-II) Dtd. 04.06.2020 and subsequent orders are eligible to bid in this tender. **Bids received from Class II & Non-local supplier shall be rejected**."

18. Compliance to GOI order for restrictions under Rule 144 (xi) of General Financial Rules (GFRS), 2017 (Annexure-XI) :

Refer clause at **Annexure-XI** and Certification at **Annexure-XII/ Annexure-XIII** (whichever is applicable) regarding restrictions under Rule 144 (xi) of General Financial Rules (GFRs), 2017. Bidder to comply the clause and submit the certification. Non-compliance/ Non-submission of certification will lead to rejection of Offer.

19. MoP Circular (Annexure-XIV):

Bidder to comply the MOP circular dated 02-07-2020 **(Annexure-XIV)** and its subsequent amendment, if any, in prescribed format **(Annexure-XV)**. Non-compliance/ Non-submission will lead to rejection of Offer **(Not Applicable for cases where local content is 100%).**

20. Variation in Contract Value and Quantities:

BHEL shall have the right to variation in quantities of items within **+/- 10%** of the total Purchase Order / Contract value at the time of placement of PO or award of Contract on overall basis for all amendments together within two years from the date of original Purchase Order. The purchaser shall have the right to increase or decrease quantity and scope up to the above extent of value and seller/contractor shall be bound to accept the same at the contracted prices without any escalation.

21. Unpriced Bid:

Vendor to furnish unpriced bid mentioning "Quoted" against each BOQ line item and % of GST quoted in tender as per **Annexure-III.**

23. Details of Bidder:

Bidder to submit their complete contact information details as per **Annexure-IV.**

25. Evaluation Criteria:

Evaluation shall be done on total cost to BHEL basis.

26. Deviations:

a) Technical Deviation: No Technical Deviation is envisaged.
b) Commercial Deviation: No Commercial Deviation is envisaged.

26. Risk Purchase: (Also refer Annexure-VIII):

In case the Supplier/ Contractor fails to supply or fails to comply with terms & conditions of the Purchase Order/ Contract or delivers equipment/ material not of the contracted quality or fails to adhere to the contract specifications or fails to perform as per the activity schedule and there are sufficient reasons even before expiry of the delivery/ completion period to justify that supplies shall be inordinately delayed beyond contractual delivery/ completion period, BHEL reserve the right to cancel the Purchase Order/ Contract either in whole or in part thereof without compensation to Supplier/ Contractor and if BHEL so desires, may procure such equipment/ material/ items not delivered or others of similar description where equipment/ material/ items exactly complying with particulars are not readily procurable in the opinion of BHEL which is final and in such manner as deemed appropriate, at the risk and cost of the Supplier/ Contractor and the Supplier/ Contractor shall be liable to BHEL for any excess

cost to BHEL. However, the Supplier/ Contractor shall continue execution of the Purchase Order/ Contract to the extent not cancelled under the provisions of this clause.

Recovery amount on account of purchases made by BHEL at the risk and cost of Supplier/ Contractor shall be the difference of total value of new Purchase Order (PO) value and total value of old Purchase Order for applicable items, where the total value of new PO is more than total value of old PO for applicable items, plus additional 5% of the total ex-works value of new PO as overheads.

The Supplier/ Contractor shall on no account be entitled to any gain on such risk & cost purchase. In case the purchase order (PO) value of the new PO is less than the PO value of the old PO, 5% of the total ex-works value of the new PO shall be recovered as overheads and the difference between the PO value of the old PO and the new PO shall not be considered for calculation of the recovery amount.

29. RXIL (TReDS) Platform:

TBG is registered with RXIL (TReDS) platform. MSME bidders are requested to get registered with RXIL (TReDS) platform to avail the facility as per GoI guidelines.

30. Latent Defect Warranty:

The period of latent defect warranty shall be 10 years reckoned from the completion of Guarantee period.

31. Bidder to submit **sealed and signed copy of the following** while uploading bid in GeM portal:

a) Bid Specific ATC: This document.
b) Annexure-I: Technical Pre-Qualification Requirement along with supporting documents.
c) Annexure-II: Activity Schedule
d) Annexure-III: Unpriced Bid
e) Annexure-IV: Contact Details of Bidder
f) Annexure-V: Local Content Self-Certification
g) Annexure-VI: Schedule of Commercial Deviation
h) Annexure-VII: Schedule of Technical Deviation
i) Annexure-X: Inspection Charges
j) Annexure-XII: Compliance to Government of India Order OM NO.6/18/2019-PPD Dtd. 23.07.2020 regarding restrictions under rule 144 (xi) of the General Financial Rules (GFRs), 2017
k) Annexure-XIII: Compliance to Government of India Order OM NO.6/18/2019-PPD Dtd. 23.07.2020 regarding restrictions under rule 144 (xi) of the General Financial Rules (GFRs), 2017
l) Annexure-XV: Vendor Compliance Format
m) Annexure- XVI: Integrity Pact

Note: In case of non-receipt of above documents, the bidder is liable for rejection.

32. All other terms & conditions shall be as per GTC of GeM.

Signature of the authorized representative of

Place : .....
Date : .....

Bidder's Name : .....
Designation : .....
Company Seal : .....

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-I

Technical Pre-Qualifying Requirements Circuit Breaker– 420kV:

2X500 MVA, 400/220 kV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 kV BAY EXTN AT DUBURI

Technical requirements for 420kV Air Insulated Switchgear (AIS) Equipment – Circuit Breaker:

(i) The manufacturer(s) whose 420kV Circuit Breakers are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 345 kV or higher voltage class Circuit Breaker(s), which are in satisfactory operation# for atleast two (2) years as on the date of techno commercial bid opening i.e 11th February 2022.

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Notes:

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
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ANNEXURE-II

ACTIVITY SCHEDULE

SN	ACTIVITY	ACTIVITY TIME [in weeks]	REMARKS
	PO / Input receipt from BHEL	1	BHEL SCOPE
1.	Submission of Documents necessary for getting manufacturing clearance like Drawings, Data sheet MQP etc.	3	SUPPLIER SCOPE
2.	Manufacturing Clearance along with approved CAT-1 Drawings	2	BHEL SCOPE
3.	Manufacturing time and raising of Inspection Call	14	SUPPLIER SCOPE
4.	BHEL/Customer Inspection & Dispatch Clearance	3	BHEL SCOPE
5.	Dispatch	2	SUPPLIER SCOPE
Activity Time for supply:		**25 Weeks**	

1. Inspection call to be raised by vendor 1 week in advance.
2. Supplier must ensure the completeness and correctness of the requisite documents before submission for approval. Delay in approval on account of incomplete / inadequate information shall be the responsibility of supplier.
3. Inspection call should be given in the prescribed format only. Inspection calls not in the prescribed format shall not be entertained.
4. Vendor to ensure resubmission of drawings / documents within 1 Week from the date of comment given by BHEL
5. Qty to be offered for inspection should be in accordance within Delivery-schedule – lot. BHEL reserves the right not to entertain multiple inspection calls for a Delivery – lot and delay on this account shall be the responsibility of Supplier.

Signature of the authorized representative of

Place : ……..
Date : ……..

Bidder's Name : ……
Designation : ……
Company Seal : ……

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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ANNEXURE-III

UNPRICED BID

Sl. No.	Item Description	Unit	Quantity	Total Ex-works	GST on Total Ex-works	Total F&I	GST on Total F&I	Total cost to BHEL
1.	SUPPLY- CIRCUIT BREAKER: 420KV, 63KA FOR 3S, 3150A THREE PHASE SF6 CIRCUIT BREAKER (WITH PROVISION OF CSD), WITHOUT CLOSING RESISTOR, WITH CORONA SHIELDING, OPERATING MECHANISM, INSULATORS, BASE FRAME, HV TERMINAL PLATES, CONTROL CABINET, SUPPORT STRUCTURE, CABLE GLANDS, LADDER (IF APPLICABLE), MARSHALLING BOX (IF APPLICABLE) AND OTHER ACCESSORIES, COMPLETE IN ALL RESPECTS	NO	3	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
2.	SUPPLY- CIRCUIT BREAKER : 420KV, 63KA FOR 3S, 3150A THREE PHASE SF6 CIRCUIT BREAKER WITHOUT CSD, WITHOUT CLOSING RESISTOR, WITH CORONA SHIELDING, OPERATING MECHANISM, INSULATORS , BASE FRAME, HV TERMINAL PLATES, CONTROL CABINET, SUPPORT STRUCTURE, CABLE GLANDS, LADDER (IF APPLICABLE), MARSHALLING BOX (IF APPLICABLE) AND OTHER ACCESSORIES, COMPLETE IN ALL RESPECTS	No	2	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
3.	SUPPLY- CIRCUIT BREAKER: CONTROLLED SWITCHING DEVICE FOR 3-PH CIRCUIT BREAKER	No	3	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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4.	SUPPLY- CIRCUIT BREAKER: 420KV, FOUNDATION BOLTS FOR CIRCUIT BREAKER, PLATFORM AND LADDER (IF APPLICABLE) AND MARSHALLING BOX (IF APPLICABLE)	LOT	1	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
5.	SUPPLY- CIRCUIT BREAKER : 420KV, SPECIAL CABLES FOR CB / CSD / RP INTERFACING. MODE OF MEASUREMENT SHALL BE CABLE-TRENCH RUNNING LENGTH FROM CIRCUIT BREAKER TO CSD/ RELAY PANEL	MTR	125	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
6.	SERVICES- CIRCUIT BREAKER: 400KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF CIRCUIT BREAKER	No	5	Quoted	Quoted **Mention GST % Quoted**	NA	NA	Quoted
7.	SERVICES- CIRCUIT BREAKER: 420KV, SUPERVISION OF ERECTION TESTING AND COMMISSIONING OF CONTROLLED SWITCHING DEVICE FOR 3-PH CIRCUIT BREAKER	No	3	Quoted	Quoted **Mention GST % Quoted**	**NA**	**NA**	Quoted
8.	SPARES- CIRCUIT BREAKER: CLOSING COIL	No	10	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
9.	SPARES- CIRCUIT BREAKER: TRIPPING COIL	No	10	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
10.	SPARES- CIRCUIT BREAKER: SF6 GAS FILLING DEVICE	No	1	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
11.	SPARES- CIRCUIT BREAKER: SET OF GASKETS, "O" RINGS, SEALS PER CIRCUIT BREAKER	Set	1	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

Signature of the authorized representative of

Place : ……..

Date : ……..

Bidder's Name : ……

Designation : ……

Company Seal : ……

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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ANNEXURE-IV

CONTACT DETAILS OF BIDDER

Work Address	
Correspondence Address	
PAN NO.	
GST No.	
Details of contact person for clarification regarding bid:	
Contact Person Name	
Designation	
email ID	
Mobile No.	
Landline No.	

Signature of the authorized representative of

Place : ……..

Date : ……..

Bidder's Name : ……

Designation : ……

Company Seal : ……

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-V

Item/ Package Name	**400kV Circuit Breaker**
GeM Bid No.	
Project	**OPTCL DUBURI (400kV AIS-EXT)**
Percentage of Local Content	**…….%**

Format of Self-certification regarding Local Content in line with PPP-MII order, 2017 and its revision Dtd. 04.06.2020.

Date: ……

I …… S/o, D/o, W/o, …… Resident of …… hereby solemnly affirm and declare as under:

That I will agree to abide by the terms and conditions of the Public Procurement (Preference to Make in India) Order, 2017 (*hereinafter PPP-MII order*) of Government of India issued vide Notification No. P-45021/2/2017-BE-II Dtd. 15.06.2017, its revision Dtd. 04.06.2020 and any subsequent modifications/ amendments**,** if any**.**

That the information furnished hereinafter is correct to the best of my knowledge and belief and I undertake to produce relevant records before the procuring entity/ BHEL or any other Government authority for the purpose of assessing the local content of goods/ services/ works supplied by me for …… *(Enter the name of the Equipment/ Item for Project)*.

That the local content for all inputs which constitute the said goods/ services/ works has been verified by me and I am responsible for the correctness of the claims made therein.

That the goods/ services/ works supplied by me for …… *(Enter the name of the Equipment/Item for Project)* contains ……..% *(mention the Local content in %age)* Local Content.

That the value addition for the purpose of meeting the 'Minimum Local Content 'has been made by me at …… (*Enter the details of the location(s) at which value addition is made)*.

That in the event of the local content of the goods/ services/ works mentioned herein is found to be incorrect and not meeting the prescribed supplier class categorization criteria as per said order, based on the assessment of procuring agency(s)/ BHEL/ Government Authorities for the purpose of assessing the local content, action shall be taken against me in line with the PPP-MII order and provisions of the Integrity pact/ Bidding Documents.

I agree to maintain the following information in the Company's record for a period of 8 years and shall make this available for verification to any statutory authority:

i. Name and details of the Local Supplier
   (Registered Office, Manufacturing unit location, nature of legal entity)
ii. Date on which this certificate is issued
iii. Goods/ services/ works for which the certificate is produced
iv. Procuring entity to whom the certificate is furnished
v. Percentage of local content claimed and whether it meets the Minimum Local Content prescribed
vi. Name and contact details of the unit of the Local Supplier(s)
vii. Sale Price of the product
viii. Ex-Factory Price of the product

ix. Freight, insurance and handling
x. Total Bill of Material
xi. List and total cost value of input used to manufacture the Goods/ to provide services/ in construction of works
xii. List and total cost of input which are domestically sourced. Value addition certificates from suppliers, if the input is not in-house to be attached
xiii. List and cost of inputs which are imported, directly or indirectly

For and on behalf of …… *(Name of firm/ entity)*

Authorized signatory (To be duly authorized by the Board of Directors)
(Insert Name, Designation and Contact No.)

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-VI

SCHEDULE OF COMMERCIAL DEVIATION

The following are the deviations/ variations exception from the General Terms and Conditions:

Sl. No.	Clause No. of Terms and Conditions	Statement of Deviation
	Nil Deviation	**Nil Deviation**

In case, this schedule is not submitted, it will be presumed that the equipment/ material to be supplied under this contract is deemed to be in compliance with the General Terms and Conditions.

If there is **Nil Deviation**, even then the format to be filled as **Nil Deviation**.

Note:

1. Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.
2. Deviation mentioned in this schedule shall only be considered.

This Format is to be submitted in original duly signed by bidder. Reproduction of the same in any sort is not acceptable.

Signature of the authorized representative of

Place : ……..
Date : ……..

Bidder's Name : ……
Designation : ……
Company Seal : ……

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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ANNEXURE-VII

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations/ variations exception from the Technical Specifications:

Sl. No.	Clause No. of Technical Specifications	Statement of Deviation
	Nil Deviation	**Nil Deviation**

In case, this schedule is not submitted, it will be presumed that the equipment/ material to be supplied under this contract is deemed to be in compliance with the Technical Specifications.

If there is **Nil Deviation**, even then the format to be filled as **Nil Deviation**.

Note:

3. Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.
4. Deviation mentioned in this schedule shall only be considered.

This Format is to be submitted in original duly signed by bidder. Reproduction of the same in any sort is not acceptable.

Signature of the authorized representative of

Place : .....
Date : .....

Bidder's Name : .....
Designation : .....
Company Seal : .....

ANNEXURE-VIII

RISK PURCHASE

1.1 In case the Supplier/ Contractor fails to supply or fails to comply with terms & conditions of the Purchase Order/ Contract or delivers equipment/ material not of the contracted quality or fails to adhere to the contract specifications or fails to perform as per the activity schedule and there are sufficient reasons even before expiry of the delivery/ completion period to justify that supplies shall be inordinately delayed beyond contractual delivery/ completion period, BHEL reserve the right to cancel the Purchase Order/ Contract either in whole or in part thereof without compensation to Supplier/ Contractor and if BHEL so desires, may procure such equipment/ material/ items not delivered or others of similar description where equipment/ material/ items exactly complying with particulars are not readily procurable in the opinion of BHEL which is final and in such manner as deemed appropriate, at the risk and cost of the Supplier/ Contractor and the Supplier/ Contractor shall be liable to BHEL for any excess cost to BHEL. However, the Supplier/ Contractor shall continue execution of the Purchase Order/ Contract to the extent not cancelled under the provisions of this clause.

1.2 Risk & Cost Clause, in line with Conditions of Contract may be invoked in any of the following cases:

a) Contractor/ supplier's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor/ supplier including unexecuted portion of work/ supply does not appear to be executable within balance available period considering its performance of execution.
b) Withdrawal from or abandonment of the work by contractor/ supplier before completion as per contract.
c) Non-completion of work/ Non-supply by the Contractor/ supplier within scheduled completion/delivery period as per Contract or as extended from time to time, for the reasons attributable to the contractor/ supplier.
d) Termination of Contract on account of any other reason(s) attributable to Contractor/ Supplier.
e) Assignment, transfer, subletting of Contract without BHEL's written permission resulting in termination of Contract or part thereof by BHEL.
f) Non-compliance to any contractual condition or any other default attributable to Contractor/ Supplier.

1.3 Risk and Cost amount against Balance Work:

In case Risk & Cost is invoked, the amount of Risk & Cost against balance work shall be calculated as under:

Risk & Cost Amount = [(A-B) + (A x H/100)]

where,
A = Value of Balance scope of Work/ Supply (*) as per rates of new contract
B = Value of Balance scope of Works/ Supply (*) as per rates of old contract being paid to the contractor/ supplier at the time of termination of contract i.e. inclusive of PVC & ORC, if any.
H = Overhead Factor to be taken as 5 (five)

In case (A-B) is less than 0 (zero), value of (A-B) shall be taken as 0 (zero).

***(Balance scope of work/ supply)**

Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for 'Termination of Contract', shall be taken as balance scope of Work/ Supply for calculating risk & cost amount.

Contract quantities are the quantities as per original contract. If Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities.

Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to contractor from time to time till issue of Termination letter, then for these items total Quantities as per issued drawings would be deemed to be contract quantities.

Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions.

However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose.

Note: Incase portion of work is being withdrawn, contract quantities pertaining to portion of work withdrawn shall be considered as 'Balance scope of work/ supply' for calculating Risk & Cost amount.

1.4 LD against delay in executed Work/ Supply in case of Termination of Contract:

LD against delay in executed Work/ Supply shall be calculated in line with LD clause of the contract for the delay attributable to contractor/ supplier. For this purpose, contract value shall be taken as Executed Value of work/supply for the purpose of limiting maximum LD value.

Method for calculation of "LD against delay in executed Work/ supply" is given below:

a) Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor/ supplier = T1
b) Let the value of executed work/ supply till the time of termination of contract = X
c) Let the Total Executable Value of work/ supply for which inputs/ fronts were made available to contractor/ supplier and were planned for execution till termination of contract = Y
d) Delay in executed work/ supply attributable to contractor/ supplier i.e. T2 = [1-(X/Y)] x T1
e) LD shall be calculated in line with LD clause of the Contract for the delay attributable to contractor/ supplier taking "X" as Contract Value and "T2" as delay attributable to contractor/ supplier.

Note: In case portion of service/ supply is withdrawn, no LD shall be applicable for portion of service/ supply withdrawn.

1.5 Recovery from Supplier:

Recoveries from contractor/ supplier on whom risk & cost has been invoked shall be as per Clause No. 26 of Bid Specific ATC.

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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ANNEXURE-IX

CHECKLIST FOR SUPPLY BILLS

Name of Project	
Package Description	
Invoice No. & Date	
PO No. & Date	

Sl. No.	Documents Required	Copies	Check Points	Page No.	Vendor Remarks (Y/ N/ NA)	Verification by MM (Y/ N/ NA)	Verification by Finance (Y/ N/ NA)
1	Original for Buyer Invoice - GST compliant invoice	1 Original + 2 Copy	1. Please ensure GST complaint invoice in original				
			2. Consignee address: BHEL C/o followed by site address				
			3. Item description and unit of quantity are matched with PO				
			4. Buyer address and GSTN No. as required (TBG Noida or Nodal agency)				
			5. PO No. and Date, LR No. and Date, Vehicle No. and Project Name are mentioned				
			6. Invoiced quantity are not more than the PO quantity and MICC quantity				
			7. Ex-works unit rate, Taxes and F&I rates are same as per PO				
			8. Signed and stamped by vendor				
2	Receipted LR (signed & stamped)/ confirmation from site regarding receipt of packages/ boxes	1 Original + 2 Copy	2. Consignee address: BHEL C/o followed by site address				
			2. In case of material purchased from sub vendor, Consignee address Vendor's name C/o BHEL C/o site address				
			3. Vendor's Invoice No. and Vehicle No. are mentioned				
			4. No. of boxes/ No. of packages are same as per Packing List				
			5. In case of and adverse remark on LR (Like shortages/ damages/ broken, etc.), clarification from site/ MM/ Commercial is needed				
			6. LR is readable				
			7. In case of photocopy, LR is verified by MM				
			8. LR Date is after the Date of MICC/ (MDCC if issued) or same Date				
3	Packing list - showing number of packages, and gross weight/ net weight (if applicable)	1 Original + 2 Copy	1. PO No. and Date, LR No. and Date, Invoice No. and Date, Site Name and Address, Consignor and Consignee Address are mentioned				

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			2. Item description and quantity are matched with Invoice and PO				
			3. Signed and stamped by vendor				
			4. No. of packages/ Item descriptions are matched with MRC and LR				
4	MICC from BHEL	1 Original + 2 Copy	1. BHEL MICC has been issued prior to the Date of dispatch or on same Date				
			2. In case where MICC Date is after the Date of dispatch then MDCC Date is same or prior to the Date of dispatch				
			3. Project Name, PO, PO Date, Vendor's Name and Address is correct				
			4. Item description, Quantity and unit of quantity are same as per PO and Invoice				
			5. All hold point in MICC, if any, have been resolved before submission of bill				
			6. Signed and stamped by BHEL Executive				
			7. MICC and MDCC quantity are not less than Invoice quantity and cover all invoiced items				
5	Guarantee Certificate	1 Original + 2 Copy	1. Project Name, PO No., Invoice No., LR No. and Date are mentioned				
			2. Guarantee Certificate is strictly matched with PO T&C				
			3. Signed and stamped by vendor				
6	Bank Guarantee	1 Copy	1. Ensure submission of BG directly from Bank before supply of material so that BG confirmation may be arranged before processing the bill				
			2. Bill can be processed only after receipt of BG confirmation directly from bank				
			3. It should be in the name of BHEL, TBG Noida with registered office address Siri Fort, New Delhi				
			4. It should be in prescribed format				
			5. BG value and validity plus claim period should be minimum as specified in PO/ RC. Please check before supply. If BG extension is required please arrange the same				
			6. Vendor's name address should be same as per PO				
			7. PO No./ RC No. and Date should be correct				

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7	Insurance Certificate	1 Original + 2 Copy	1. Invoice No. and Date, Vendor's Name, Place from Consignor to Consignee are mentioned				
			2. It has not been issued later than the LR Date				
			3. Insured value is not less than the Invoice value				
			4. Signed and stamped by Insurance Company				
			5. In case of Open Insurance Policy, declaration has been submitted to Insurance Company as per declaration clause of Open policy and copy of open policy is also enclosed				
			6. In case of any discrepancy, consent of Commercial is required for processing the bill and amount will be deducted for invalid Insurance certificate				
8	PVC (if applicable) Invoice is submitted along with the Dispatch Invoice	1 Original + 2 Copy	PVC (If applicable) Invoice is submitted along with the Dispatch Invoice				
			1. PVC Invoice is attached along with Supply Invoice				
			2. Calculation sheet and applicable PVC indices are also enclosed				
			3. If delay in delivery, then PVC indices are as per PO conditions				
9	Material Receipt Certificate		1. LR No. and Date, Invoice No. and Date, Vehicle No. and Date, Site Name an address are mentioned				
			2. Date of receipt of material				
			3. Item description and quantity are same as per Invoice/ Packing List				
			4. It is signed and stamped by Site Executive				
			5. In case of any shortages/ damages/ adverse remark, clarification is needed				
10	Other Documents		To be seen as per specific requirement of PO				
To be filled by BHEL-MM only							
11	Date of Submission of Last Billing Document		Date to be mentioned		**Not to be filled by Vendor**		
12	LD Calculation, if applicable, as per PO		Calculation Sheet of LD due to delay in delivery is attached				
13	Receipted LR (signed & stamped)/ confirmation from site regarding	1 Copy	Damages, if any mentioned in the Receipted LR have been accounted for. Withheld amount, if any_____				

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
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	receipt of packages/ Boxes						
14	Packing List - showing number of packages and gross weight & net weight (if applicable)	1 Original	If Packing List does not match with Purchase order (with reference to Sl. No. 4 above), Engineering/ MM acceptance as to the completeness is enclosed				
15	PO copy	1 Copy	PO copy with original seal and signature is attached along with amendment, if any				
16	DAN	1 Copy	Relevant DANs are attached duly signed by MM representative				
***Note:**	**Every field to be ticked. If some document is not applicable, same should be mentioned. All Pages to be numbered upward from the bottom page**						
	Invoice Control No.				Vendor Signature	MM Signature	Finance Signature
					Date:	Date:	Date:

ANNEXURE-X

38.0 INSPECTION COST: (REF CL NO. 18 OF ITB--Section-II of Vol-I):

38.1 Expenses in respect of OPTCL's representative for witnessing the inspection & testing of the offered equipment/materials at the inspection and testing site.

- The testing and inspection of the equipment/ materials at manufacturer works are in the scope of work of the Contractor/Supplier. Travel Expenses of OPTCL Representative & Third Party Inspecting Agency (TPIA) shall be borne by the Contractor. However the Inspection Fees payable to TPIA will be borne by OPTCL.
- OPTCL inspecting officer and Third Party Inspecting Agency (TPIA), on receipt of offer for inspection from the contractor/supplier, shall proceed to the manufacturer works to witness the Type/Acceptance/Routine test.

38.2 The travel expenses under the following heads, in respect of OPTCL's representative and TPIA for witnessing the inspection & testing of the offered equipment/materials at the inspection and testing site, shall be borne by the contractor.

a) Hotel Accommodation:

I. Single room accommodation in 4 star hotel for OPTCL/TPIA inspecting officer, not below the rank of Assistant General Manager (Grade E-6),

II. Single room accommodation in 3 star hotel for OPTCL/TPIA inspecting officer of the rank below Assistant General Manager (Grade E-6).

N.B.: It is the responsibility of the contractor to arrange the hotel accommodation matching with their inspection and testing schedule. In case of extended duration of inspection or non-availability of the return ticket, Contractor shall arrange for the extended stay of the inspecting officer in the Hotel accordingly. In case, there is no hotel with prescribed standard in and around the place of inspection, the contractor shall suggest alternative suitable arrangement at the time of offer for inspection, which is subjected to acceptability of OPTCL inspecting officer.

b) Journey of the Inspecting Officer:

(i) To and fro travel expenditure from the Head Quarters of the inspecting officer to the place of inspection/testing shall be borne by the contractor as per the following.

- Journey from the Head Quarters to the nearest Airport by train (Ist/IInd A/C) or Taxi (A/C).
- Journey from destination Airport to the place of inspection/testing by train (Ist/IInd A/C) or Taxi (A/C).
- For train journey, inspecting officer, not below the rank of Assistant General Manager shall be provided with 1st class AC ticket and inspecting officer below the rank of Assistant General Manager shall be provided with 2nd class AC ticket.

(ii) Booking/cancellation of Air-ticket / Train-ticket is the responsibility of the contractor.

(iii) Moreover, if during the journey there is an unavoidable necessity for intermediate travel by road/ waterway/sea-route, the contractor/supplier shall provide suitable conveyance to the inspecting officer for travel this stretch of journey or bear the cost towards this. Any such possibilities shall be duly *intimated to OPTCL at the time of their offer for inspection.*

c) Local Conveyance:

Local journey for the inspecting officer between Hotel and the place of the inspection/testing site, Air-conditioned four wheeler vehicles in good condition shall be provided by the contractor.

ANNEXURE-XI

CLAUSE REGARDING RESTRICTIONS UNDER RULE 144 (XI) OF THE GENERAL FINANCIAL RULES (GFRS), 2017 AS PER GOVERNMENT OF INDIA ORDER OM NO.6/18/2019-PPD DTD. 23.07.2020

I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.

II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not failing in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.

III. "Bidder from a country which shares a land border with India" for the purpose of this Order means:

a) An entity Incorporated, established or registered in such a country; or
b) A subsidiary of an entity Incorporated, established or registered in such a country; or
c) An entity substantially controlled through entitles incorporated, established or registered in such a country; or
d) An entity whose beneficial owner is situated in such a country, or
e) An Indian (or other) agent of such an entity; or
f) A natural person who is a citizen of such a country; or
g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

IV. The beneficial owner for the purpose of (iii) above will be as under:

1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.

   Explanation:
   a) "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent. of shares or capital or profits of the company;
   b) "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholder's agreements or voting agreements;

2. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;

3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of Individuals;

4. Where no natural person is Identified under (1) or (2) or (3) above the beneficial owner is the relevant natural person who holds the position of senior managing official;

5. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

V. An Agent is a person employed to do any act for another or to represent another in dealings with third person.

VI. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

- The above clause is not applicable to the bidders from those countries (even if sharing a land border with India) to which the GoI has extended lines of credit or in which the GoI is engaged in development projects.
- List of countries to which lines of credit have been extended or in which development projects are undertaken are available on the Ministry of External affairs website (https://www.mea.gov.in/).

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SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XII

VENDOR COMPLIANCE FORMAT IN BIDDER LETTER HEAD

COMPLIANCE TO GOVERNMENT OF INDIA ORDER OM NO.6/18/2019-PPD DATED 23.07.2020 REGARDING RESTRICTIONS UNDER RULE 144 (XI) OF THE GENERAL FINANCIAL RULES (GFRS), 2017

Sl. No.	Description	Bidder's confirmation
1.	*We, M/s …… have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; We hereby certify that we are not from such a country.*	Agreed

Note: Non-compliance of above said GoI Order and its subsequent amendment, (if any), by any bidder(s) shall lead for commercial rejection of their bids by BHEL.

Signature of the authorized representative of

Place : ……..
Date : ……..

Bidder's Name : ……
Designation : ……
Company Seal : ……

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
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ANNEXURE-XIII

VENDOR COMPLIANCE FORMAT IN BIDDER LETTER HEAD

COMPLIANCE TO GOVERNMENT OF INDIA ORDER OM NO.6/18/2019-PPD DATED 23.07.2020 REGARDING RESTRICTIONS UNDER RULE 144 (XI) OF THE GENERAL FINANCIAL RULES (GFRS), 2017

Sl. No.	Description	Bidder's confirmation
1.	*We, M/s …… have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India. We are from such a country which shares a land border with India & have been registered with the Competent Authority as specified in above said order. We hereby certify that we fulfil all requirements in this regard and are eligible to be considered.* ***Evidence of valid registration by the Competent Authority is attached.***	Agreed

Note: Non-compliance of above said GoI Order and its subsequent amendment, (if any), by any bidder(s) shall lead for commercial rejection of their bids by BHEL.

Signature of the authorized representative of

Place : ……..
Date : ……..

Bidder's Name : ……
Designation : ……
Company Seal : ……

PROJECT	OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XIV

No.25-111612018-PG
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi • — 110001
Tele Fax: 011-23730264

Dated 02/07/2020

ORDER

Power Supply System is a sensitive and critical infrastructure that supports not only our national defence, vital emergency services including health, disaster response, critical national infrastructure including classified data & communication services, defence installations and manufacturing establishments, logistics services but also the entire economy and the day-today life of the citizens of the country. Any danger or threat to Power Supply System can have catastrophic effects and has the potential to cripple the entire country. Therefore, the Power Sector is a strategic and critical sector.

The vulnerabilities in the Power Supply System & Network mainly arise out of the possibilities of cyber attacks through malware / Trojans etc. embedded in imported equipment. Hence, to protect the security, integrity and reliability of the strategically important and critical Power Supply System & Network in the country, the following directions are hereby issued:-

1. All equipment, components, and parts imported for use in the Power Supply System and Network shall be tested in the country to check for any kind of embedded malware/trojans/cyber threat and for adherence to Indian Standards.
2. All such testings shall be done in certified laboratories that will be designated by the Ministry of Power (MOP).
3. Any import of equipment/components/parts from "prior reference" countries as specified or by persons owned by, controlled by, or subject to the jurisdiction or the directions of these "prior reference" countries will require prior permission of the Government of India
4. Where the equipment/components/parts are imported from "prior reference" countries, with special permission, the protocol for testing in certified and designated laboratories shall be approved by the Ministry of Power (MOP).

This order shall apply to any item imported for end use or to be used as a component, or as a part in manufacturing, assembling of any equipment or to be used in power supply system or any activity directly or indirectly related to power supply system.

This issues with the approval of Hon'ble Minister of State for Power and New & Renewable Energy (Independent Charge).

(Goutam Ghosh)
Director Tel: 011-23716674 To:

1. All Ministries/Departments of Government of India (As per list)
2. Secretary (Coordination),Cabinet Secretariat
3. Vice Chairman, NITI Aayog

PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XV

VENDOR COMPLIANCE FORMAT IN BIDDER LETTER HEAD

In view of order No. 25-111612018-PG, Dated 02.07.2020 of Ministry of Power, GOI

GEM BID NO.	
PROJECT	**OPTCL NEW DUBURI, ODISHA (400 kV AIS-EXT)**
ITEM	**400kV Circuit Breaker**

This is to certify that all equipment, components, and parts imported for use in the Power Supply System and Network are in strict compliance to directions issued by Ministry of Power, Govt. of India vide order No. 25-111612018-PG Dtd. 02.07.2020. The imported component(s), part or assembly item(s) does not carry any malware/ Trojan, etc.

Note: Non-compliance of MoP Order and its subsequent amendment(s), (if any), by vendor shall lead to rejection of their offer or cancellation of contract, which is awarded by BHEL.

Signature of the authorized representative of

Place : ……..

Date : ……..

Bidder's Name : ……

Designation : ……

Company Seal : ……

Annexure-XVI

INTEGRITY PACT:

Bidders shall have to enter into Integrity Pact with BHEL, duly signed with seal in original, if specified in NIT / RFQ failing which bidder's offer shall be liable for rejection.

(a) IP is a tool to ensure that activities and transactions between the company and its bidders/contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitor (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

Details of IEM for this tender is furnished below
Name: Shri Arun Chandra Verma, IPS (Retd.)
Email: acverma1@gmail.com

Name: Shri Virendra Bahadur Singh, IPS (Retd.)
E-mail: vbsinghips@gmail.com

(b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-1, in case of Two/three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this pact would be a preliminary qualification.

(c)Please refer section -8 of the IP for Role and responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEM shall be done through e-mail only.

Note: No routine correspondence shall be addressed to the IEM (Phone/post/email) regarding the clarification, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/issues shall be addressed directly to the tender issuing (procurement) department's officials as mentioned on Point 2 & 3.

Annexure XI

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____ _____ _____ . The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions:

Section 2 - Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

4.1 If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent Earnest Money Deposit/ Bid Security.

4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to

demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 - Equal treatment of all Bidders/ Contractors / Sub-contractors

6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.

6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 - Independent External Monitor(s)

8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.

8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.

8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.

8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.

8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.

8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.

8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.12 The word `Monitor' would include both singular and plural.

Section 9 - Pact Duration

9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.

9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

For & On behalf of the Principal

(Office Seal)

For & On behalf of the Bidder/ Contractor

(Office Seal)

Place----------

Date----------

Witness: Sandeep Kumar

(Name & Address) BHEL-TBG, Sector-16A, Noida

Witness: Nandlal Verma

(Name & Address) BHEL-TBG, Sector-16A, Noida

Technical Pre-Qualifying Requirements Circuit Breaker– 420kV:

2X500 MVA, 400/220 kV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 kV BAY EXTN AT DUBURI

Technical requirements for 420kV Air Insulated Switchgear (AIS) Equipment – Circuit Breaker:

(i) The manufacturer(s) whose 420kV Circuit Breakers are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 345 kV or higher voltage class Circuit Breaker(s), which are in satisfactory operation# for atleast two (2) years as on the date of techno commercial bid opening i.e 11th February 2022.

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Notes:

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Prepared By: Nishant Singh (Dy. Manager) 2/05/23

Checked By: Neeraj Kumar (DGM) 02.05.2023

Approved By: Sanjeev K. Shrivastava (Sr DGM) 02/05/2023

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

DOCUMENT No.	**TB-420-316-001-D**	Rev. No.	**00**	Prepared	Checked	Approved
TYPE OF DOC.	**TECHNICAL SPECIFICATION**			SIGN	04.05.23	
TITLE				NAME	**NS**	**NK**	**SKS**
420kV Circuit Breaker				DATE	02/05/2023	02/05/2023	02/05/2023
				GROUP	**TBEM**	W.O. No	**I22TB00002**
CUSTOMER	***ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)***						
PROJECT	**2X500 MVA, 400/220 kV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 kV BAY EXTN AT DUBURI**						
CA NO.	**349/2022-23 dated 30.12.2022**						
Station	**400kV AIS BAY EXTN., DUBURI**						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS

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SECTION-1

Scope, Bill of Quantity, Specific Technical Requirements

1.1 Scope

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site and supervision of erection, testing & commissioning of 420kV Circuit Breaker complete in all respect for efficient & trouble-free operation mentioned under this specification.

The equipment is required for the following project:

Name of the customer:	**ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)**
Name of the project:	**2X500 MVA, 400/220 kV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 kV BAY EXTN AT DUBURI**
Site:	**400kV AIS BAY EXTN., DUBURI**

***Note: The terms used in this specification namely, "Employer" refers to OPTCL, "OPTCL/PURCHASER" refers to BHEL/OPTCL, "Contractor/SUPPLIER" refers to Bidder, "GTR" refers to "section-3".**

In case of any conflict among the various sections of this specification, the order of precedence shall be section 1, section 2 & the section 3.

1.2 Bill of Quantities

1.2.1 Main Supply:

S. No.	Item Description	Unit	Quantity	Remarks
			Duburi	
1	SUPPLY- CIRCUIT BREAKER: 420KV, 63KA FOR 3S, 3150A THREE PHASE SF6 CIRCUIT BREAKER (WITH PROVISION OF CSD), WITHOUT CLOSING RESISTOR, WITH CORONA SHIELDING, OPERATING MECHANISM, INSULATORS, BASE FRAME, HV TERMINAL PLATES, CONTROL CABINET, SUPPORT STRUCTURE, CABLE GLANDS, LADDER (IF APPLICABLE), MARSHALLING BOX (IF APPLICABLE) AND OTHER ACCESSORIES, COMPLETE IN ALL RESPECTS	Nos.	3	Only provision for CSD is required. Supply of Main CSD is covered in item at sl. No. 3 below.
2	SUPPLY- CIRCUIT BREAKER : 420KV, 63KA FOR 3S, 3150A THREE PHASE SF6 CIRCUIT BREAKER WITHOUT CSD, WITHOUT CLOSING RESISTOR, WITH CORONA SHIELDING, OPERATING MECHANISM, INSULATORS , BASE FRAME, HV TERMINAL PLATES, CONTROL CABINET, SUPPORT STRUCTURE, CABLE GLANDS, LADDER (IF APPLICABLE), MARSHALLING BOX (IF APPLICABLE) AND OTHER ACCESSORIES, COMPLETE IN ALL RESPECTS	Nos.	2	
3	SUPPLY- CIRCUIT BREAKER: CONTROLLED SWITCHING DEVICE FOR 3-PH CIRCUIT BREAKER	Nos.	3	
4	SUPPLY- CIRCUIT BREAKER: 420KV, FOUNDATION BOLTS FOR CIRCUIT BREAKER, PLATFORM AND LADDER (IF APPLICABLE) AND MARSHALLING BOX (IF APPLICABLE)	Lot	1	
5	SUPPLY- CIRCUIT BREAKER : 420KV, SPECIAL CABLES FOR CB / CSD / RP INTERFACING. MODE OF MEASUREMENT SHALL BE CABLE-TRENCH RUNNING LENGTH FROM CIRCUIT BREAKER TO CSD/ RELAY PANEL	Mtr	125	
6	SERVICES- CIRCUIT BREAKER: 400KV, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF CIRCUIT BREAKER	Nos.	5	For breakers under supply i.e item at sl no. 1 & 2 above.
7	SERVICES- CIRCUIT BREAKER: 420KV, SUPERVISION OF ERECTION TESTING AND COMMISSIONING OF CONTROLLED SWITCHING DEVICE FOR 3-PH CIRCUIT BREAKER	Nos.	3	

1.2.2 Mandatory Spares:

S. No.	Item Description	Unit	Quantity
			Duburi
1	SPARES- CIRCUIT BREAKER: CLOSING COIL	Nos.	10

2	SPARES- CIRCUIT BREAKER: TRIPPING COIL	Nos.	10
3	SPARES- CIRCUIT BREAKER: SF6 GAS FILLING DEVICE	Nos.	1
4	SPARES- CIRCUIT BREAKER: SET OF GASKETS, "O" RINGS, SEALS PER CIRCUIT BREAKER	Set	1

Notes –

1. The above quantities may vary ± 10%.

2. Prices for all applicable accessories of Circuit Breakers shall be included in the equipment prices.

3. Respective dates for the commencement of erection, testing and commissioning activities of Circuit Breakers shall be communicated to manufacturers from time to time as per the readiness of respective sites.

4. For item at clause 1.2.1, sl. No. 4, each lot is defined as the total quantity required for successful completion of all circuit breakers under supply.

1.3 Specific Technical Requirements

1.3.1 Technical Parameters - 420kV Circuit Breaker

Sl. No.	Item	Requirements
1.	Rated voltage (KV rms) frequency (Hz)	420kV 50Hz
2.	Continuous current rating (A) rms	3150
3.	Type	Outdoor SF6
4.	Mounting	Hot dip galvanized lattice/welded steel support structure to be supplied by the Bidder
5.	Number of Poles	3
6.	Type of Operation	Individually Operated Single poles.
7.	Phase to phase spacing in the switchyard i.e. inter pole spacing for breaker (mm)	7000 maximum or as per manufacturer type test design, in field requirement is 6000mm.
8.	Required ground clearance from the lowest live terminal up to ground including plinth (mm):	
i.	If both the terminals are not in the same horizontal plane	7000
ii.	If both the terminals are in the same horizontal plane	7000
9.	Height of concrete plinth (to be provided by the Owner) mm.	300

10.	Minimum height of the lowest part of the support insulator from ground level (mm)	3500
11.	Operating Mechanism	FOR 420 KV /SPRING-SPRING/
12.	Autoreclosing duty	Single Phase for 420kV
13.	Rated operating duty cycle	0-0. 3 sec-co-3 min-co
14.	First pole to clear factor	1.3(As per IEC-62271-100)
15.	Type of tripping	Trip free
16.	Max. closing time(ms)	Less than 100
17.	Max. BREAK TIME (ms)	40
18.	1.2/50 microsecond impulse withstand voltage: (dry)	
i.	To earth(kvp)	1425
ii.	Across the open contacts with impulse on one terminal and power frequency voltage on opposite terminal (kvp)	1425
19.	1 minute power frequency withstand voltage (kv rms) (wet)	For 420kV Circuit Breaker shall be 520kVrms across phase to earth and 610kV rms across open contacts
20.	Max. radio interference voltage (micro volts) at 1.1 times maximum phase voltage	1000
21.	Min. corona extinction voltage (kv rms)	320
22.	Rated breaking current capacity:	
i.	Line charging at rated voltage at 90 deg. Leading power factor (A) rms	400
ii	Small inductive current (A) rms	----------0.5 to 10---------- without switching o/v exceeding 2.3 p.u.
iii.	Short circuit current	
a.	AC component (kA)	63
b.	% DC component	50%/as per IEC62271-100
23.	Rated short circuit making current capacity (kA)	158
24.	Permissible limit of temperature rise	As per Clause 5.27 of Section 2
25.	Max. acceptable difference in the instant of closing/opening of contacts	
i.	Within a pole (ms)	2.5
ii	Between poles (ms)	3.3 for opening &5 for closing
26.	Min. Creepage distance of support insulator(mm)	10500
27.	Short time current carrying capability for three second (kA)	63
28.	Rating of auxiliary contacts	----10A at 220 V D.C.---- Besides requirement of technical

		specification, the bidder shall wire up 16 NO + 16 NC contacts exclusively for purchaser's use and wired up to common marshalling box.
29.	Breaking capacity of auxiliary contact	2 A DC with the circuit time constant not less than 20 ms
30.	Noise level at base and upto 50 metres	-----140 dB (max.)----------
31.	Seismic acceleration	--------0.3 g ----------

Notes:

i. All cables within & between circuit breaker poles and its marshalling box and up to the controlled switching device shall be in bidder's scope of supply. Bidder to provide detailed "**Bill of Quantity**" during detailed engineering stage.
ii. Cabling & termination schedule for the same shall be provided by successful bidder along with AS MANUFACTURED drawing during contract stage.
iii. TB's for incoming AC Power Cables shall be suitable for size (minimum) **4Cx16** sq. mm. Al.
iv. LED luminaries/light is to be provided as per technical requirement (minimum 7 watt).
v. Following minimum accessories are clarified as bidder's scope of supply
- **Structure** for Equipment support, Ladder & Platform etc.
- **Foundation bolts** for Circuit Breaker, CB ladder, CB Platform, common control cubicle.
- **Cable Tray** arrangement to be mounted on Breaker structure.
- Breaker **Terminal pad**.

vi. Following are not in bidder's scope of supply (BHEL supplied items)
- Terminal Connectors.

For other parameters, refer respective section 2 for the applicable voltage class of Circuit Breakers.
For CSD requirements, please refer section 2.

1.3.2 Technical Qualifying Requirement

Technical requirements for 420kV Air Insulated Switchgear (AIS) Equipment – Circuit Breaker:

(i) The manufacturer(s) whose 420kV Circuit Breakers are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 345 kV or higher voltage class Circuit Breaker(s), which are in satisfactory operation# for atleast two (2) years as on the date of techno commercial bid opening i.e 11th February 2022.

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Notes:

#: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

1.3.3 Type Tests

All the equipment offered shall be fully type tested as per the relevant standards (IEC-62271 -100, IEC-60694/IS-12729 with latest amendments) & tests as indicated below. The bids offering equipment not type tested will be rejected. In case, the equipment of the type & design offered has already been type tested, the bidder shall furnish four sets of the type test reports along with the offer. The test must have been conducted not earlier than Ten years from the date of opening of the bids i.e. 11th February 2022. For any change in the design/type already type tested the design/type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost or reject the bid without any intimation.

Type Tests: -- (As per IEC-62271-100 with latest amendments)

1) Dielectric Test (LI Voltage, PF Voltage Withstand (Dry & Wet) & etc.)
2) RIV Test
3) Measurement of resistance of the main circuit
4) Temperature rise Test
5) Short Time withstand current & Peak withstand current Test
6) Tightness Test
7) Mechanical Operation Test, Mechanical endurance test
8) Short Circuit making & Breaking Test
9) Capacitive Current, Switching Test, Line charging current breaking Test
10) Test to verify degree of protection

Additional type tests: -

1) Corona extinction voltage test (As per Section 2 Annexure-I)
2) Out of phase closing tests per IEC
3) Line charging breaking current test
4) Seismic Withstand test in unpressurised condition (as per Section 2 Annexure-I)

1.3.4 SUPERVISION OF ERECTION COMMISSIONING AND TESTING:

The erection, testing and commissioning of the breakers shall be supervised, by trained personnel (Engineer) of the supplier who shall direct the sequence of ET&C and make the necessary adjustments to the apparatus and correct in the field any errors or omissions in order to make the equipment and material properly perform in accordance with the intent of this specification. The Engineer shall also instruct fully (up to the satisfaction) to the plant operators, in the operation

and maintenance of equipment furnished. The supplier shall be responsible for any damage to the equipment, on commissioning the same, if such damage results from faulty or improper ET&C procedure. Purchaser shall provide adequate number of skilled/semi-skilled workers and cranes required for breaker erection, at his own expense. Apart from the above, the purchaser shall not be responsible for any other expenses incurred by the supplier and against personal injuries to the Engineer etc., shall be to supplier 's account. Special tools like **SF6 gas leak detector, SF6 gas filling adopter, timing kit and Transducer for operational analyzer and any other tool, required for erection and commissioning shall be arranged by the supplier at his cost and on commissioning these shall be supplied to the purchaser, free of cost, for future use.**

The measurement at site shall be carried out as per Section-2 Technical Specification. The commissioning report shall be prepared and signed by the manufacturer's representative.

Following Instruments shall be made available by BHEL to testing engineer
a) DCRM (Operational analyser) Kit
b) 5kV Insulation tester
c) 1kV Insulation tester
d) Single phase variac
e) Dew Point meter
f) Capacitance and Tan Delta Kit
g) Contact Resistance measurement kit
h) Multimeter

Any other instrument(s), if required for Testing/commissioning of Circuit Breaker shall be arranged by bidder. Cost of the same shall be deemed inclusive in the offer.

The respective dates of commencement of erection, testing and commissioning activities by BHEL will be intimated to the equipment supplier from time to time, so that arrangements for supervising the activity can be made accordingly by the manufacturer.

1.3.5 Special Tools and Tackles

Bidder shall supply all special tools and tackle (other than maintenance tools as if mentioned in BOQ) which are specifically required for Circuit Breakers and are proprietary in nature. Cost of the same shall be deemed inclusive in the offer for main item. List of such special tools and tackle should be clearly listed along with the technical offer. Any special tool which is not listed in the technical spec / bid but required during the erection/commissioning of Circuit Breakers shall also be supplied by the bidder without time / cost implication.
In case, special tools and tackles which is proprietary in nature is not required for Erection/testing/commissioning or for smooth operation of Circuit Breaker, supplier has to submit a certificate mentioning that no special tools and tackles is required for Circuit Breakers.

1.3.6 Quality Plan

The successful bidder shall submit Quality Assurance Plan for 420kV Circuit Breaker & its accessories etc. including in-process inspection methods, tests, records, etc. for BHEL/ OPTCL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ OPTCL. In case bidder has reference, Quality Assurance Plan agreed with BHEL/ OPTCL, same shall be submitted for specific project to BHEL/ OPTCL approval. There shall be no commercial implication to BHEL/ OPTCL on account of Quality Plan approval. Refer section 2 of technical specification also.

1.3.7 Drawings & Engineering Documents

Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings. List of drawings required for technical clearance of manufacturing are as follows:

a) General outline drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.

b) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.

c) Schematic diagrams of breaker offered for control supervision and reclosing.

d) Structural drawing, design calculations and loading data for support structures.

e) Foundation drilling plan and loading data for foundation design.

f) Type test reports

For additional details refer section 2.

1.3.8 Deviations

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

SECTION-2

Refer OPTCL's Technical Specification, "TECHNICAL SPECIFICATION FOR **420**, 245, 145, & 36 KV CIRCUIT BREAKERS – TS E11 CIRCUIT BREAKER" – [70 pages]

OPTCL
Lifeline of Odisha

ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

FOR

420, 245, 145, & 36 KV CIRCUIT BREAKERS

BHEL, Transmission Business Group
BHEL
Industry Sector
Noida-05

i. 420 KV SF6 CIRCUIT BREAKER

~~ii. 245KV SF6 CIRCUIT BREAKER~~

~~iii. 145 KV SF6 CIRCUIT BREAKER~~

~~iv. 36 KV VCB~~

420/245/145 KV CIRCUIT BREAKERS

1.0 SCOPE

1.1 This specification provides for the design, manufacture, inspection and testing before dispatch, packing and delivery F.O.R. (destination) By Road transport only and supervision of erection, testing and commissioning, of outdoor SF6 circuit breakers along with structures, all the accessories and auxiliary equipment and mandatory spares, described herein, required for their satisfactory operation in various substations of the state.

1.2 The circuit breaker shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material, which, in his judgement, is not in full accordance therewith.

2.0 STANDARDS

2.1 Except as modified in this specification, the circuit breakers shall conform to the latest revisions with amendments thereof, of following standards.

SL. NO.	STANDARD	TITLE
1.	IEC-62271-100	High Voltage Alternating Current Circuit-Breaker
2.	IS-12729:2004/IEC-60694	Common Specification for High Voltage Control gear & Switchgear standard
3.	IS-14658/IEC-1633	H.V Alternating Current Ckt Breaker-Guide for Short Ckt & Switching Test Procedures for metal enclosed & dead tank Circuit Breaker
4.	IS-14674:1999/IEC-1166:1993	H.V Alternating Current Ckt Breaker-Guide for Seismic qualification of HV A.C Circuit Breaker
5.	IEC-56 / IS 13118	Specification for alternating current circuit breakers
6.	IS-325	Specification for three phase induction motors
7.	IS-375	Marking and arrangement for switchgear bus bar main

		connections and auxiliary wirings.
9.	IS-802 (Part-1)	Code of practice for use of structural steel in overhead trans. Line towers.
10.	IS-2099	High voltage porcelain bushings.
11.	IS-2147	Degree of protection provided for enclosures for low voltage switchgear and control gear.
12.	IS-2629	Recommended practice for hot dip galvanizing of iron and steel
13.	IS-4379	Identification of the contents of Industrial Gas Cylinders.
14.	IS-7311	Seamless high carbon steel cylinders for permanent and high pressure liquefied gases.

2.2 Equipment meeting with the requirements of any other authoritative standards, which ensures equal or better quality than the standard mentioned above shall also be acceptable. If the equipment offered by the Bidder conforms to other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Two copies of such standards with authentic English Translations shall be furnished along with the offer.

2.3 The standards mentioned above are available from:

Reference/Abbreviation	Name and address from which the standards are available
IS	Bureau of Indian Standards, Nanak Bhawan, 9-Bahadur Shah Zafar Marg, New Delhi 110 001 INDIA
IEC	International Electrotechnical Commission Bureau Central De la Commission Electro Technique International 1,Rue De Verembe Geneva Switzerland

3.0 AUXILIARY POWER SUPPLY

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

(a)	Power Devices like drive Motors of rating 1 KW and above.	415 V, 3 phase 4 wire 50Hz, neutral grounded AC supply.
(b)	Lighting, space heaters and Fractional KW motors.	240 V, single phase, 50 Hz neutral grounded AC supply
(c)	Alarm, control and Protective devices.	220 V DC, 2 wire

Each of the foregoing supplies shall be made available by the Purchaser at the terminal point for each circuit breaker for operation of accessories and auxiliary equipment. Supplier's scope include supply of interconnecting cables, terminal boxes etc The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

i) AC supply voltage ± 10% frequency ± 5%

i) DC supply : - 15% to + 10%

4.0 PRINCIPAL PARAMETERS Refer parameters for 420kv CB Only

The breakers shall conform to the specific technical requirements specified hereunder:

Sl. No.	Item	Requirements	
		145 KV	245KV/420KV
1	Rated voltage (KV rms) frequency (Hz)	145 50HZ	245/420 KV 50HZ
2	Continuous current rating (A) rms	3150	3150/3150

3.	Type	Outdoor SF6	
4.	Mounting	Hot dip galvanized lattice/welded steel support structure to be supplied by the Bidder	
5.	Number of Poles	3	
6.	Type of Operation	Gang Operated	Individually Operated Single poles.
7.	Phase to phase spacing in the switchyard i.e. inter pole spacing for breaker (mm)	2150 maximum or as per manufacturer type test design	4500 maximum or as per manufacturer type test design / 7000 maximum or as per manufacturer type test design
8.	Required ground clearance from the lowest live terminal up to ground including plinth (mm)		
	i. If both the terminals are not in the same horizontal plane	-	4800/7000
	ii. If both the terminals are in the same horizontal plane	4600	6500/7000
9.	Height of concrete plinth (to be provided by the Owner) mm.	300	300
10.	Minimum height of the lowest part of the support insulator from ground level (mm)	2550	2550/3500
11.	Operating Mechanism	spring charged(Spring-Spring) FOR 420 KV /SPRING-SPRING/	
12.	Autoreclosing duty	Three phase for 145 KV & Single Phase for 245 & 420 KV	

13.	Rated operating duty cycle	0 0. 3 sec-co-3 min-co	
14.	First pole to clear factor	1 3(As per IEC-62271-100)	
15.	Type of tripping	Trip free	
16.	Max closing time(ms)	Less than 100	
17.	Max. BREAK TIME (ms)	Less than 60	50/40
18.	1.2/50 microsecond impulse withstand voltage: (dry)		
	i. To earth(kvp)	650	1050/ 1425
	ii. Across the open contacts with impulse on one terminal and power frequency voltage on opposite terminal (kvp)	650	1050/ 1425
19.	1 minute power frequency withstand voltage (kv rms) (wet)	275	460/for 420kV Circuit Breaker shall be 520kVrms across phase to earth and 610kV rms across open contacts
20.	Max. radio interference voltage (micro volts) at 1.1 times maximum phase voltage	500	500/1000
21	Min. corona extinction voltage (kv rms)	92	156/320
22	Rated breaking current capacity:		
	i Line charging at rated voltage at 90 deg. Leading power factor (A) rms	50	125/400
	ii. Small inductive current (A) rms	---------0.5 to 10------------ without switching o/v exceeding 2.3 p.u.	
	iii. Short circuit current		
	a) AC component (kA)	40	40 or 50/ 63

		b)	% DC component	40% / as per IEC62271-100	50%/as per IEC62271-100
23.	Rated short circuit making current capacity (kA)			79	100/125/ 158
24.	Permissible limit of temperature rise			As per Clause 5.29	
25.	Max acceptable difference in the instant of closing/opening of contacts				
		i)	Within a pole (ms)	5	5/2.5
		ii)	Between poles (ms)	10	10/3.3 for opening &5 for closing
26.	Min. creepage distance of support insulator(mm)			3,625	6,125/10500
27.	Short time current carrying capability for three second (kA)			40	40/50/63
28.	Rating of auxiliary contacts			----10A at 220 V D.C.----	
29.	Breaking capacity of auxiliary contact			2 A DC with the circuit time constant not less than 20 ms	
30.	Noise level at base and upto 50 metres			-----140 dB (max.)----------	
31.	Seismic acceleration			--------0.3 g ----------	

Note:-Purchaser may accept the phase to phase, or phase to earth spacing of the breakers &structure heights basing on the firm's type test reports or he may ask the firm to manufacture the breakers as per the dimensions indicated in this specification. .

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 Circuit breaker offered shall be sulphur hexafluoride (SF6) type only

5.2 Any part of the breaker, especially the removable ones, shall be freely interchangeable without the necessity of any modification at site

5.3 Circuit breaker shall comprise of three identical single pole units. If the circuit breaker not meant for single pole reclosure, these units shall be linked together electrically. Complete circuit breaker with all the necessary items for successful operation shall be supplied, including but not limited to the following:

5.3.1 Breaker assemblies with bases, support structure for circuit breaker as well as for control cabinet, Ladder, central control cabinet and foundation bolts for main structure as well as control cabinet and central control cabinet (except concrete foundations), terminals and operating mechanisms.

5.3.2 Compressed SF6 gas, spring operated systems complete including piping, fittings, valves and controls and etc.

5.3.3 For 420/220kV CB, One central control cabinet for each breaker (if applicable) and one control box/operating mechanism for each pole with all the required electrical devices mounted therein and the necessary terminal blocks for termination of inter pole wiring. For 145kV CB, common operating mechanism for complete breaker is acceptable. The necessary inter pole cabling at site shall be done by the Purchaser based on the schematic, wiring diagram and termination schedule to be supplied by the Supplier.

5.3.4 Instruments, pressure gauges and other devices like gas density monitor, temp. monitor & etc. for SF6 gas pressure supervision.

5.3.5 All necessary parts to provide a complete and operable circuit breaker installation such as main equipment, terminal, control parts, connectors and other devices, whether specifically called for herein or not.

5.4 The circuit breaker shall be designed for high speed single and three pole reclosing with and operating sequence and timing as specified in clause 4.0 "Principal Parameters".

5.5 The support structure of circuit breaker as well as that of control cabinet shall be hot dip galvanized. The minimum weight of zinc coating shall be ~~610 gm/sq.m~~ 910 gm/sqm and minimum thickness of coating shall be ~~86~~ 127 microns for all items thicker than 5 mm.

5.6 Circuit breaker shall be suitable for hot line washing.

5.7 ~~All breakers shall be supplied with terminal connectors. The exact requirement of terminal connectors would be intimated to the supplier during the course of detailed engineering (during drawing approval).~~

5.8 Terminal pads/~~Terminal connector~~ shall be made up of high quality electrolytic copper or Aluminium alloy Terminal pads made of copper shall have silver plating of at least 50 microns thickness. Terminal pads/~~Terminal connector~~ shall be suitable for an ambient temperature of +50deg c

5.9 CONTACTS

5.9.1 All making and breaking contacts shall be sealed free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacements due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

5.9.2 Main contacts shall be first to open and the last to close so that there will be little contact burning and wear. If arcing contacts are used they shall be first to close and the last to open. Main contacts will be adequately silver coated. Arcing contacts are made up of highly resistive material.

5.9.3 Any device provided for voltage grading to damp oscillations or to prevent restrike prior to the complete interruption of the circuit or to limit over voltages on closing shall have a life expectancy comparable to that of the breaker as a whole.

5.9.4 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life or the material used. The temperature shall not exceed that indicated in IEC-56 under specified ambient conditions.

5.9.5 Contacts shall be kept permanently under pressure of SF6 gas. The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage continuously at zero gauge pressure of SF6 gas due to its leakage

5.9.6 If multi break interrupters are used these shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculations/test reports in support of the same shall be furnished along with the bid. The thermal and voltage withstands of the grading elements shall be adequate for the service conditions and duty specified.

5.10 PORCELAIN HOUSING

5.10.1 The porcelain housing shall be of single piece construction without any joint or coupling. It shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric

strength. Glazing of porcelain shall be uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog) The type and profile of the porcelain insulator sheds shall be in accordance with IEC-815 joints as per IEC-233.

5.11 ADDITIONAL REQUIREMENTS

a) The circuit breakers shall be single pressure type, the design and construction of the circuit breaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surface of the circuit breaker.

b) All gasketed surfaces shall be smooth, straight and reinforced, if necessary to minimize distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals, Double –O—ring seals and test holes for leakage test of the internal seal shall be provided on each static joint.

c) In the interrupter assembly there shall be an absorbing product box to eliminate SF6 decomposition products and moisture The material used in the construction of the circuit breakers shall be fully compatible with SF6 gas.

d) In case of 420/245kV CB, each pole shall form an enclosure filled with SF6 gas independent of two other poles. The SF6 density of each pole shall be monitored and regulated by individual pressure switches. For CBs of voltage class of 145 kV a common SF6 scheme/density monitor shall be acceptable.

e) The SF6 gas density monitor shall be adequately temp. compensated. The density monitor shall meet the following requirements:

i) It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by using suitable interlocked non-return couplings.

ii) It shall damp the pressure pulsation while filling the gas in service so that the flickering of the pressure switch contacts does not take place.

iii) A pressure indicator (pressure gauge) shall also be supplied.

f) Means for pressure relief shall be provided (if required) in the gas chamber of circuit breaker to avoid the damages or distortion during occurrence of abnormal pressure increase or shock waves generated by internal electric fault occurs. The position of vents, diaphragms and pressure relief devices shall be so arranged as the minimize danger to the operators in the event of gas or vapour escaping under pressure.

g) Facility shall also be provided to reduce the gas pressure within the breaker to a value not exceeding 8 millibars within 4 hours or less Each circuit breaker shall be capable of withstanding this degree of vacuum without distortion or failure of any part

h) Sufficient SF6 gas shall be provided to fill all the circuit breakers installed. In addition to this 20% of the total gas requirement shall be supplied as spare requirement.

i) Provisions shall be made for attaching an operation analyzer after installation at site to record contact travel, speed and making measurement of operation timings, pre insertion timing of closing resistor, synchronization of contacts in one pole

5.12 SULPHUR HEXAFLUORIDE GAS (SF6 GAS) :

a) The SF6 gas shall comply with IEC 376, 376A and 376B and be suitable in all respects for use in the switchgear under the worst operating conditions.

b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations:

IS:4379 Identification of the contents of industrial gas cylinders.

IS: 7311 Seamless high carbon steel cylinders for permanent and high pressure liquifiable gases.

The cylinders shall also meet Indian Boiler regulations.

c) Test: SF6 gas shall be tested for purity, dew point, break down voltage, water contents as per IEC-376, 376A and 376B and test certificates shall be furnished to owner indicating all the tests as per IEC-376 for each lot of SF6 gas.

5.13 PREINSERTION RESISTOR (PIR)

DELETED

5.14 DUTY REQUIREMENTS

5.14.1 The circuit breaker shall be totally restrike free under all duty conditions. Opening resistors shall not be used.

5.14.2 The circuit breaker shall meet the duty requirements for any type of fault or fault location, for line charging and dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily. It shall withstand the maximum expected dynamic loads (including the seismic) to which the circuit breaker may be subjected during its service life.

5.14.3 The circuit breaker shall be capable of:

i) Interrupting the steady and transient magnetizing current corresponding to 420 kv/245 KV; 245/145 KV; 245/36 KV and 145/36 KV class transformers of 500 MVA; 160 MVA;63 MVA & 63 MVA ratings respectively.

ii) Interrupting line charging current as given in clause 4.0, "Principal Parameters" of this specification with a temporary overvoltage as high as 1.5 p.u. without restrikes.

iii) Clearing short line faults (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified

iv)Breaking inductive currents a minimum of 100A without switching overvoltage exceeding 2.3 p.u.

v) Breaking 25% of the rated fault current at twice rated voltage under phase opposition condition

5.14.4 The critical current, which gives the longest arc duration at lockout pressure of extinguishing medium and the arc duration shall be indicated

5.14.5 The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges. The breaker shall ALSO WITHSTAND THE VOLTAGE SPECIFIED IN CLAUSE 4.0 "principal Parameters" of this specification.

5.15 TOTAL BREAK TIME

5.15.1 The "Total Break Time" as specified in clause 4.0, "Principal Parameters" of this section shall not be exceeded under any of the following duties:

i)Test duties 1,2,3,4,5 (with TRV as per IEC-62271-100)/as per related IS.

ii)Short line fault L90, L75 (with TRV as per IEC-62271-100) /as per related IS.

5.15.2 The Bidder may please note that there is only one specified break time of the breaker which shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, (70-110%) spring-spring operation and arc extinguishing medium pressure etc while furnishing the proof for the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between contacts within a pole or between poles and show how it is covered in the guaranteed total break time

5.15.3 The values guaranteed shall be supported with the type test reports.

5.16 OPERATING MECHANISM AND ASSOCIATED EQUIPMENTS

5.16.1 The circuit breaker shall be designed for electrical local as well as remote control. In addition there shall be provision for local mechanical control (emergency trip)

5.16.2 SPRING OPERATED MECHANISM:

The operating mechanism for 420 Kv/245 KV / 145 KV class breakers shall be of **spring –spring type only** operated by electrical control. The mechanism shall be adequately designed for the specified tripping and re closing duty The entire operating mechanism control circuitry & etc as required, shall be housed in an outdoor type, with **Aluminium alloy enclosure (minimum 3mm thickness)**. This enclosure shall conform to the degree of protection IP 55 of IS- 2147.

5.16.3 All working parts in the mechanism shall be of corrosion resistant material. All bearings which require greasing, shall be equipped with pressure grease fittings.

5.16.4 The design of the operating mechanism shall be such that it shall be practically maintenance free. The guaranteed years of maintenance free operation, the number of full load and full rated short circuit current breaking/operation without requiring any maintenance or overhauling, shall be clearly stated in the bid. As far as possible the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether if possible.

5.16.5 The operating mechanism shall be non-pumping (and trip free) electrically and mechanically under every method of closing. There shall be no rebounds in the mechanism and it shall not require any critical adjustments at site. Operation of the power operated closing device, when the circuit breaker is already closed, shall not cause damage to the circuit breaker or endanger the operator, provision shall be made for attaching an operation analyzer to facilitate testing of breaker at site.

5.16.6 A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet.

(a) 145 kV CB offered CB is with integrated mechanism the operation counter is provided in mechanism. Operating mechanism indicator shall be clearly visible from ground.

(b) 245 & 420 kV since offered breakers are individually operated shall have operation counter in each mechanism. Operating mechanism indicator shall be clearly visible from ground.

5.16.7 The supplier shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

5.16.8 The Breaker shall have spare auxiliary switches for Owners use (I.e, for Interlocking, indication, contacts to main and back up relay etc). A minimum of 16 N/O (52a) & 16 N/C (52b) spare auxiliary switch contacts should be provided.

5.17 CONTROL

5.17.1 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

5.17.2 Each breaker pole (420 & 245 KV) and Each breaker of 145 KV shall be provided with two (2) independent tripping circuits, valves and coils each connected to a different set of protective relays.

5.17.3 The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However provisions shall be made for local electrical

control. For this purpose a local / remote selector switch and close and trip push buttons shall be provided in the breaker central control cabinet Remote located push buttons and indicating lamps shall be provided by purchaser.

5.17.4 The trip coils shall be suitable for trip circuit supervision The trip circuit supervision relay would be provided by the purchaser. Necessary terminals shall be provided in the central control cabinet of the circuit breaker by the supplier.

5.17.5 Closing coil shall operate correctly at all values of voltage between **85% and 110%** of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between **70% and 110%** of rated voltage. However, even at 50% of rated voltage, the breaker shall be able to perform all its duties. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on outdoor circuit breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details the offer is likely to be rejected.

5.17.6 Suitable relay for monitoring of DC supply voltage to the control cabinet shall be provided. The pressure switches used for interlock purposes shall have adequate contact ratings to be directly used in the closing and tripping circuits. In case the contacts are not adequately rated and multiplying relays are used then the interlock for closing/opening operation of breaker shall be with No logic of the relay i.e if the DC supply to the interlock circuit fails then operation lockout shall take place.

5.17.7 For all types of operating mechanism a local manual closing device which can be easily operated by one man standing on the ground shall also be provided for maintenance purposes and direction of motion of handle shall be clearly marked Operating mechanism shall be accessible with a ladder with proper steps with support hand rail.

5.17.8 The auxiliary switch of the breaker shall be preferably positively driven by the breaker operating rod and where due to construction features, same is not possible a plug in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.

5.18 MOTOR COMPRESSED SPRING CHARGING MECHANISM

Spring operated mechanism shall be complete with motor, **opening spring, closing spring** and all other necessary accessories to make the mechanism a complete unit Breaker operation shall be independent of motor which shall be used solely for the purpose of charging the closing spring. Motor rating shall be such that it requires only 15 seconds for fully charging the closing spring. Closing operation shall compress the opening spring and keep ready for tripping. The mechanism shall be provided with means for charging the spring by hand This operation shall

be carried out with the doors of the cubicle open. During the process no electrical or mechanical operation of the mechanism shall endanger the operator or damage the equipment. A mechanical indicating device shall be provided to indicate the state of the charge spring and shall be visible with the door of the cubicle closed. An alarm shall be provided for spring failing to be charged within a pre set time after circuit breaker closing. The spring mechanism shall be fitted with a local manual release, preferably by a push button to avoid inadvertent operation. Means shall be provided for discharging the spring when the circuit breaker is in the open position without circuit breaker attempting to close.

Opening spring and closing spring with limit switches for automotive charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided

As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible The motor shall have adequate thermal rating for this duty.

After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

Breaker operations shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it requires not more than 15 seconds for full charging of the closing spring.

Closing action of the breaker shall compress the opening spring ready for tripping.

When closing spring are discharged after closing a breaker, closing spring shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism

Provision shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition Mechanical interlocking shall be provided in the operating mechanism to prevent discharging of closing spring when the breaker is already in the closed position.

5.18.1 OPERATED MECHANISM FOR 400 KV BREAKERS.

The operating mechanism for 420 KV circuit breakers shall also be spring operated mechanism.(Closing spring and opening also spring).

5.19 OPERATING MECHANISM HOUSING

The operating mechanism housing/control cabinet shall conform to the requirement specified in clause 5.29. The entire operating mechanism and control mechanism control circuitry & etc as required, shall be housed in an outdoor type made out of **Aluminium alloy sheet of 3mm thickness** enclosure. This enclosure shall conform to the degree of protection IP-55 of IS-2147

5.20 INTERLOCKS

It is proposed to electrically interlock the circuit breaker with purchaser's associated air break isolating switches in accordance with switch yard safety interlocking scheme. The details of the scheme will be furnished to the supplier. All accessories required on breaker side for satisfactory operation of the scheme shall be deemed to be included in the scope of supply of this specification.

5.21 SUPPORT STRUCTURE

The supplier shall indicate the price of support structure along with the foundation bolts required separately in the bid proposal sheets and these shall be considered in evaluation. Purchaser reserves the right to procure these from the supplier or through separate contract. However, in case the equipment offered have integral support structure or the specialties of the breaker are such that support structures have to be provided by the supplier, the prices of these support structure shall be included in the price of the equipment and same shall be indicated clearly in the bid proposal sheet. The support structure shall meet the following requirements:

1) The minimum vertical clearance from any energized metal part to the bottom of the circuit breaker (structure) base, where it rests on the foundation pad, shall be minimum 8 mtrs for 400 KV, 5.5 mtrs for 245KV & 4.6 mtrs for 145 KV.

2) The minimum vertical distance from the bottom of the lowest porcelain part of the bushings, porcelain enclosures or supporting insulators to the bottom of the circuit breaker base, where it rests on the foundation pad shall be 2.55 mtrs. for all voltages.

3) The minimum clearance between the live parts and earth shall be 3.5 mtrs for 400 KV, 2.4 mtrs for 245 KV and 1.5 meters for 145 KV or as per manufacturer type tested design proven by relevant IEC standard

5.22 FITTINGS AND ACCESSORIES

5.22.1 Following is a partial list of some of the major fittings and accessories to be furnished by supplier in the central control cabinet. Number and exact locations of these parts shall be indicated in the bid

a) Central control cabinet in accordance with clause no. 5.29 complete with

i) Cable glands.

ii) Local/remote changeover switch.

iii) Operation counter.

iv) SF6 pressure gauges.

v) Control switches to cut off control power supply.

vi) MCB's as required

vii) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 24 terminals spare for owner's use.

All the terminal blocks to be used in the operating mechanism and control cubicle should be of stud type of Poly-amide/Melamine material of make like Elmex (OAT-6 for non-disconnecting type and OAT 6T for disconnecting type) / WAGO/ Connectwell (Equivalent).

b) Anti-pumping relay.

c) Rating and diagram plate in accordance with IEC / IS incorporating year of manufacture.

5.23 PAINTING, GALVANISING AND CLIMATE PROOFING

5.23.1 All interiors and exteriors of tanks and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequence). All steel surfaces in contact with insulating oil, as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.

5.23.2 All metal surfaces exposed to atmosphere shall be given, in addition to the treatment described in clause 5.23 two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade no. 697 of IS:5.

5.23.3 Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

5.23.4 All components shall be given adequate treatment of climate proofing as per IS:3202 so as to withstand corrosive and serve service conditions.

5.24 GALVANISING

All ferrous parts including all sizes of nuts, bolts, support channels, structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS:2629. Spring washers shall be electro galvanized.

5.25 EARTHING

The operating mechanism housing, control cabinets, dead tanks, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to **75X10** mm mild steel flat to be provided by the Purchaser for connection to station earth mat.

5.26 NAME AND RATING PLATES.

Circuit breaker and its operating device shall be provided with a rating plate or plates marked with but not limited to following data:

a) Manufacturer's name or trade mark.

b) Serial Number or type designation making it possible to get all the relevant information from the manufacturer.

c) Year of manufacture.

d) Rated voltage.

e) Rated insulation level.

f) Rated frequency.

g) Rated normal current.

h) Rated short circuit breaking current.

i) First pole to clear factor

j) Rated duration of short circuit.

k) Rated auxiliary D.C. supply voltage of closing and opening devices.

l) Rated pressure of compressed air gas for operation and interruption.

m) Rated out of phase breaking current.

n) Rated supply voltage of auxiliary circuits.

o) Rated supply frequency of auxiliary circuits.

p) Number of closing & Tripping coils

q) Opening time & closing time

Other information are as per IS 12729/IEC 60694

The coils of operating devices shall have a reference mark permitting the data to be obtained from the manufacturer

The rating plate shall be visible in position of normal service and installation. The rating plate shall be weather proof and corrosion proof.

5.27 LIMITS OF TEMPERATURE RISE

The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50 deg. C. If the maximum ambient temperature rises, permissible values shall be reduced accordingly.

Sl. No.	Nature of the part or of the liquid	Maximum Value of	
		Temp.	Temp. rise at a max. ambient air temp. not exceeding 40 deg. C.
1.	Contacts in air, silver-faced copper, copper alloy or aluminium alloy [see notes (i) and (ii)	115	75
	Bare copper or tinned aluminium alloy.	75	35
2	Contacts in oil:		
	Silver-faced copper, copper alloy or aluminium alloy (see note ii)	90	50
	Bare copper or tinned aluminium alloy	80	40
3.	Terminals to be connected to external conductors by screws or bolts silver faced (see note iii)	115	75
4.	Metal parts acting as springs	See Note iv	See note iv
5.	Metal parts in contact with insulation of the following classes:		
	Class Y: (for non-impregnated materials)	90	50
	Class A: (for materials immersed in oil or impregnated)	105	65
	Class E: in air	120	80
	in oil	100	60
	Class B in air	130	90

	in oil	100	60
	Class F: in air	155	115
	in oil	100	60
	Enamel: Oil base	100	60
	Synthetic, in air	120	80
	Synthetic, in oil	100	60
6.	Any part of metal or of insulating material in contact with oil, except contacts	100	60
7.	Oil	100	60

Notes:(i) When applying the temperature rise of 55 deg. C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.

(ii) The quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, the contacts shall be regarded as "bare"

(iii) The values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.

(iv) The temperature shall not reach a value whether the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 80 deg. C.

5.28 TERMINAL CONNECTORS

5.28.1 The terminal connectors shall meet the following requirements:

a) Terminal connectors shall be manufactured and tested as per IS: 5561

b) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

c) No part of a clamp shall be less than 10 mm thick.

d) All ferrous parts shall be hot dip galvanized conforming to IS: 2633.

e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body

f) Flexible connectors shall be made from tinned copper

g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS: 5561.

5.29 SPECIFICATION FOR CONTROL CABINETS:

1. Control cabinets shall be of the free standing floor mounting type.

2. Control cabinet of the operating mechanism shall be made out of **Aluminium alloy sheet (minimum 3 mm thickness). The operating mechanism shall be strong, rigid & not subject to rebound.** Hinged door shall be provided with padlocking arrangement. Sloping rain hood (if applicable) shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP55 as per IS: 2147.

3. Bus bars shall be of tinned copper of adequate cross-section to carry the normal current, without exceeding the permissible temperature rise over an ambient temperature of 50 deg. C outside the cubicle. The buses shall be braced to withstand forces corresponding to short circuit current of 25 KA.

4. Motors rated 1 kw and above being controlled from the control cabinet would be suitable for operation on a 415 V, 3 phase 50 Hz system. Fractional KW motors would be suitable for operation on a 240 V, 1-phase, 50 Hz supply system.

5 Isolating switches (MCBs) shall be group operated units (3 pole for use on 3-phase supply systems and 2 pole for single phase supply systems) quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Switch handle shall have provision for locking in both fully open and fully closed positions.

6 Push buttons shall be rated for not less than 6 Amps, 415 V A.C. or 2 Amps, 220 V D.C. and shall be flush mounted on the cabinet door and provided with appropriate name plates. Red, Green and Amber indicating lamps shall be flush mounted.

7 For motors up to 5 KW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor at 0.2 p.f. For motors above 5 KW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase motors and 2 pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS: 2959. The main contacts of the contactors shall be silver plated and the insulation class for the coil

shall be class E or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage

8. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting, hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed.

9. Single phasing preventer relay shall be provided for 3 phase motors to provide positive protection against single phasing.

10. Mini starters shall be provided with no volt coils whenever required.

11 Purchaser's power cables will be of 1100 volts grade stranded aluminium conductor. PVC insulated, PVC sheathed single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in supplier's scope of supply. Suitable brass cable glands shall be provided for cable entry.

12. Wiring for all control circuits shall be carried out with 1100 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 sq. mm. Atleast 10% spare terminal blocks for control wire terminations shall be provided on each panel. The terminal blocks shall be of non-disconnecting stud type. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps.

13. Separate terminal blocks shall be provided for terminating circuits of various voltage classes. CT loads shall be terminated on a separate block and shall have provision for short circuiting the CT secondary terminals.

14. Control cabinet shall be provided with 240 V, 1-phase 50 Hz, 20 W CFL TUBE light fixture and a suitably rated 240 V, 1-phase, 5 amps, 3 pin socket for hand lamps.

15. Strip heaters shall be provided inside each cabinet complete with thermostat (preferably differential type) to prevent moisture condensation. Heaters shall be controlled by suitably rated double pole miniature Circuit Breakers.

16. Signal lamps provided shall be of neon screw type with series resistors, enclosed in backelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body

17 Electric measuring instruments shall be of moving iron type. Ammeters for measuring current upto 30 Amps shall be directly connected while those for measuring above 30 Amps shall be connected through suitable CTs. Ammeters shall be provided with selector switches.

18. Items inside the cabinet made of material shall be coated with a fongus resistant varnish.

5.30 MOTORS :(UNIVERSAL MOTOR)

Motors shall be universal type suitable for operation in AC & DC supply, as per IS:325 of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment.

6.1.1 TESTS

Type Tests

All the equipment offered shall be fully type tested as per the relevant standards (**IEC-62271-100**,IEC-60694/IS-12729 with latest amendments) **& tests as indicated below**. **The bids offering equipment not type tested will be rejected.** In case, the equipment of the type & design offered has already been type tested, the bidder shall furnish four sets of the type test reports along with the offer. **The test must have been conducted not later than Ten years from the date of opening of the bids**. ~~The purchaser reserves the right to demand repetition of some or all the type & additional type tests in the presence of his representative. For this purpose, the bidder may quote unit rates for carrying out such type tests~~. For any change in the design/type already type tested the design/type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost or reject the bid without any intimation.

Type Tests:--(As per IEC-62271-100 with lattest amendments)

1) Dielectric Test(LI Voltage,PF Voltage Withstand(Dry&Wet)& etc)

2) RIV Test

3) Measurement of resistance of the main circuit

4) Temperature rise Test

5) Short Time withstand current & Peak withstand current Test

6) Tightness Test

7) Mechanical Operation Test, Mechanical endurance test

8) Short Circuit making & Breaking Test

9) Capacitive Current, Switching Test, Line charging current breaking Test

10) Test to verify degree of protection

Routine Tests:

1) Dielectric Tests on the main Circuit ,auxiliary & control circuits

2) Measurement of resistance of the main circuit.

3) Tightness Test

4) Design & Visual Checks

5) Mechanical operation Test

6) Operating time of the device, motor Characteristics, measurement of coil current & resistance , Sf6 gas pressure monitoring , control Circuit , anti-pumping, dimensions, nameplate details , contact travel & timing checks & contact speed in m/sec.

The following additional type tests are proposed to be conducted. The type test charges for these tests shall be quoted along with other type tests(AS indicated above) as per IEC/ IS in the relevant schedule & the same shall be indicated in the total bid price.

1) Corona extinction voltage test (As per Annexure-I)

2) Out of phase closing tests per IEC

3) Line charging breaking current test

4) Seismic Withstand test in unpressurised condition (as per Annexure-I)

~~6.1.2 The prices quoted by the bidder towards conductance of type tests & additional type tests shall be taken in to consideration for bid evaluation.~~

6.2 TYPE, ACCEPTANCE AND ROUTINE TESTS

6.2.1 All acceptance and routine tests as stipulated in IEC-62271-100,IEC-60694/IS-12729, IS 13118 with its latest amendments & routine tests as indicated above shall be carried out by the supplier in the presence of purchaser's representative. ~~Also type test on one unit may be carried out by the supplier in the presence of purchaser's representative if purchaser decides & if such facility will be available either in the manufacturer's laboratory or in the CPRI. Rates for these tests must be indicated in the Annexure-IV, V, of Section-III of this tender specification. If the manufacturer wants to do the above tests in free of cost, then he may indicate the rates as 'NIL'. Purchaser reserves the right to conduct type test or may not insist for this test.~~

6.2.2 In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.

Speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto reclosing and trip free operation under normal as well as limiting operating conditions (control voltage, pressure etc.) The tests shall show the speed of contacts directly at various stages of operation, travel of

contacts, opening time, closing time, shortest time between separation and meeting of contacts at break/make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console, etc shall be furnished as mandatory maintenance equipment

6.2.3 Immediately after finalization of the program of type/acceptance routine testing, the supplier shall give sufficient advance intimation (20 days) to the purchaser to enable him to depute his representative for witnessing the tests.

6.3 ADDITIONAL TESTS

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

7.0 INSPECTION

7.1 The inspection may be carried out by the purchaser at any stage of manufacture. The supplier shall grant free access to purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed in advance, about the manufacturing program so that arrangement can be made for inspection. Before offering for inspection, the supplier shall furnish shop routine test certificates and calibration reports of the equipment/instruments to be used during testing. After acceptance of these calibration reports and shop routine test certificate, inspecting officer of the purchaser will be deputed for witnessing such inspections.

7.2 The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

7.3 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested or unless the same is waived by the purchaser in writing.

8.0 QUALITY ASSURANCE PLAN:

The bidder shall invariably furnish following information along with his offer failing which his offer, shall be liable for rejection

i) Statement giving list of important raw materials including but not limited to:

(a) Contact Material

(b) Insulation

(c) Porcelain

(d) Oil

(e) Sealing material

(f) Contactor, limit switches, etc. in control cabinet.

Names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.

ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

Iii) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

iv) Special features provided in the equipment to make it maintenance free.

vi) List of testing equipment available with the Bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

vii) The supplier shall, within 30 days of placement of order, submit following information to the purchaser.

1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer

2) Type test certificates of the raw material and bought out accessories.

3) Quality assurance plan (QAP) with hold points for purchaser's inspection (if purchaser will desires).

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembling breaker

9.0 DOCUMENTATION

9.1 All drawings shall conform to relevant International Standards Organization (ISO) Specification/ISS. All drawings shall be in mk and suitable for micro filming. All dimensions and data shall be in S.I. Units.

9.2 List of Drawings and Documents:

The Bidder shall furnish four sets of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the offer.

a) General outline drawings showing dimensions and shipping weights, quantity of insulating media air receiver capacity etc.

b) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance

c) Schematic diagrams of breaker offered for control supervision and reclosing.

d) Structural drawing, design calculations and loading data for support structures.

e) Foundation drilling plan and loading data for foundation design.

f) Type test reports

9.3 The supplier shall, within 2 weeks of placement of order submit four sets of final version of all the above drawings for purchaser's approval The purchaser shall communicate his comments/approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit 15 prints and one good quality reproducibles of the approved drawings for purchaser's use.

9.4 The supplier shall also furnish fifteen copies of manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and approved drawings pertaining to the main equipment as well as auxiliary devices. Marked erection drawings shall identify the component parts of the equipment as shipped to enable purchaser to carry out erection with his own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched.

9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier risk.

9.6 TEST REPORTS

i) Four copies of acceptance test reports and type test reports shall be furnished to the purchaser as per the inspection of testing. One copy will be returned, duly certified by the purchaser and only there afterwards shall the material be dispatched.

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ii)All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.

iii)All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

10 PACKING AND FORWARDING

The equipment shall be packed in suitable crates so as to withstand handling during transit The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing and handling. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

a) Name of the consignee.

b) Details of consignment.

c) Destination.

d) Total weight of consignment.

e) Sign showing upper / lower side of the crate.

f) Handling and unpacking instructions.

g) Bill of material indicating contents of each package and spare material.

h) Manuals containing approved drawings & test reports

The supplier shall ensure that the packing list and bill of material are to be supplied in advance to the purchaser & to the consignees before dispatch.

11.0 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING (ET&C)

The erection, testing and commissioning of the breakers shall be supervised, by trained personnel (Engineer) of the supplier who shall direct the sequence of ET&C and make the necessary adjustments to the apparatus and correct in the field any errors or omissions in order to make the equipment and material properly perform in accordance with the intent of this specification The Engineer shall also instruct fully (up to the satisfaction) to the plant operators, in the operation and maintenance of equipment furnished The supplier shall be responsible for any damage to the equipment, on commissioning the same, if such damage results from faulty or improper ET&C procedure Purchaser shall provide adequate number of skilled/semi-skilled workers as well as all ordinary tools and equipment and cranes required for

breaker erection, at his own expense. Apart from the above, the purchaser shall not be responsible for any other expenses incurred by the supplier and against personal injuries to the Engineer etc., shall be to supplier's account. Special tools, if required for erection and commissioning shall be arranged by the supplier at his cost and on commissioning these shall be supplied to the purchaser, free of cost, for future use.

12.0 QUANTITY AND DELIVERY RERQUIREMENTS

i) The scope of supply shall include a supply of 25% extra-quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

SCHEDULE- A

TECHNICAL PARTICULARS AND GUARANTEES

1. Topographical and Meteorological site conditions

Location		State of ODISHA
Altitude	m	1000
Air Temperatures		
Minimum	C	0
Maximum	C	55
maximum daily average	C	32
Humidity variation	per cent	100
Pollution level to IEC 815		Heavy
Airborne contamination, if any		Highly polluted
Isoceraunic level	day/annum	70
Seismic withstand factor (all equipment)	g	0.3
Maximum wind pressure	kg/sq. m	88.92

Wind velocity - (Wind Zone to IS 875)	m/sec	55
Average annual rain fall	Cm	150

1	**SYSTEM DETAILS**	**kV**	**400**	**220**	**132**
1.1	Rated system voltage	kV	420	245	145
1.2	Earthing of system neutral		solid	solid	solid
1.3	System frequency	Hz	50	50	50
2	**INSULATION LEVEL** (at site altitude)				
2.1	Lightning impulse voltage withstand level, positive and negative polarity	kVp	1425	1050	650
2.2	Switching impulse voltage withstand level of insulation to ground, positive and negative polarity dry wet	 kVp kVp	 1050 1050	 -	
2.3	Power frequency withstand voltage dry wet	 kV kV	 520 520	 460 460	 275 275
2.4	Voltage below which corona shall not be visible	kV	320	176	105

2.5	Maximum radio interference voltage level measured at 1.1 times Us/ 3 at 1 MHz	µV	<1000	<500	<500
2.6	Minimum creepage to earth over insulation on rated service voltage (to IEC 815)	mm/kV	25	25	25

Us is rated system voltage

Creepage distance across interrupter chambers shall be at least 10 percent greater than the creepage distance to earth and shall comply with the pollution conditions of IEC 815.

2. - SWITCHGEAR DETAILS

Item No	Description		Particulars		
		kV	420	245	145
1	**TYPE OF SWITCHGEAR**				
1.1	Type of switchgear GIS or Open terminal		Open terminal		
1.2	Installation Outdoor		Outdoor	Outdoor	Outdoor
2	**SHORT TIME CURRENT CAPACITY**				
2.1	**All equipment** 3 seconds	kA	~~50~~ 63	40	40
2.2	Maintenance earthing devices, 3 seconds	kA	~~50~~ 63	40	40
3	**CIRCUIT BREAKER**				
3.1	**Normal current rating**	A	3150	3150	3150
3.2	**Fault rating**				
3.2.1	Making current	kAp	~~125~~ 158	100	100

3.2.2	Breaking current (symmetrical)	kA	~~50~~ 63	40	40
3.2.3	Breaking current (asymmetrical)	% DC/kAp	IEC 62271 100	IEC 62271-100	IEC 62271-100
3.2.4	Breaking current under out of phase conditions	kA	10	10	10
3.2.5	Rated line charging current	A	600	125 as per IEC	50 as per IEC
3.2.6	Rated cable charging current	A	600	250 as per IEC	160 as per IEC
3.2.7	Rated inductive current	A	1 to 10 - 50 - 100 – 200		
3.2.8	Maximum overvoltage factor on any switching duty	pu	<2.0	<2.0	<2.0
3.3	**Operating sequence**				
3.3.1	Normal		0-0.3 s - CO-3 min – CO		
3.3.2	Auto reclosing		0-0.3 s - CO-3 min – CO		
3.3.3	Delayed three phase auto reclose cycle adjustable dead time range	s	2-30	2-30	2-30
		kV	420	245	145
3.3.4	High speed single phase auto reclose cycle adjustable dead time	s	0.3-20	0.3-20	-
3.3.5	Number of closing operations under out of synchronous conditions	(2.0 pu)	2	2	2
3.4	**Transient recovery voltage**				
3.4.1	First phase to clear factor		1.3	1.3	1.5

	3.4.2	Recovery voltage parameter for 3 phase unearthed terminal fault		IEC 56	IEC 56	IEC 56
	3.4.3	Short line fault paramicter		IEC 56	IEC 56	IEC 56
	3.4.4	Surge impedance for short line fault test	ohms	450	450	450
	3.4.5	Minimum voltage to earth when switching capacitive currents, (1.4 times rated phase to earth voltage)	kV	340	198	117
	3.4.6	Voltage across circuit breaker under out of phase switching conditions	pu	2	2	2
	3.5	**Electro mechanical performance**				
	3.5.1	Maximum total break time throughout complete rating, ie trip coil initiation to final arc extinction	ms	40	50	50
	3.5.2	Maximum time interval between closure of first and last phase of three phase circuit breakers	ms	2	1	1
	3.5.3	Maximum time interval between closure of interrupters of one phase of the circuit breaker	ms	1	-	-
	3.5.4	Maximum time interval between opening of first and last phase of three phase circuit breaker	ms	3.3	3.3	3.3
	3.5.5	Maximum time interval between opening of interrupters of one phase of the circuit breaker	ms	1	-	-
			kV	420	245	145
4		**Insulation level (IEC 694)**				
41		Lightning impulse withstand				

Biased tests (Impulse + AC) required on switchgear for 300 kV and above

	(1.2/50 wave) - positive and negative				
	a To earth, closed contacts	kVp	1425	1050	650
	b. Across, open contacts	kVp	-	1050	650
		kVp + kVACp	1425 +(240)	-	-
4.2*	Switching impulse withstand (250/ 2500 wave) - positive and negative				
	c. To earth, closed contacts	kVp	1050	-	-
	d. Across, open contacts	kVp	1050	-	-
		kVp + kVACp	900 +(345)	-	-
4.3	Power frequency withstand	Dry/wet			
	e. To earth, closed contacts - 1 minute	kV	520	460	275
	f. Across, open contacts - 1 minute	kV	610	530	315
4.4	**Ancillary equipment**				
4.5	Number of trip coils required		2	2	2
4.6	Number of closing coils required		1	1	1
4.7	Degree of protection		IP 55	IP 55	IP 55

Wet tests are required on outdoor open-terminal switchgear

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TABLE 1. - 420KV CIRCUIT BREAKERS

(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV

Fault duty	Current kA (rms)	First test voltage U_1 (kV)	Time co-ord t_1 (µs)	TRV peak value U_c (kV)	Time co-ordt2 (µs)	Time delay td (µs)	Volt co-ord u' (kV)	Time co-ord t' (µs)	Rate of rise U'/t kV (kV/µs)
10% symmetrical	5	-	-	787	88	11	262	4	8.9
30% symmetrical	15	446	89	669	668	5(22)	223	50(67)	5.0
60% symmetrical	30	446	149	669	671	2(37)	223	76(111)	3.0
100% symmetrical	50	446	223	624	669	2	223	113	2.0
100% Asym.	**	446	223	624	669	2	223	113	2.0
Asynchronous	12.5	686	446	857	1338	-	-	-	-
100% closing	125	-	-	-	-	-	-	-	-

* Dependent on circuit breaker opening time

** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with $t_d = 0$

(B) SHORT LINE FAULT REQUIREMENTS

Source side	50	343	171	480	513	2	171	88	2.0
				U_L	t_L	t_{dL}			U_L/t_L
Line side L90	45	-	-	54.9	6.1	0.5	-	-	9
Line side L75	37.5	-	-	137.3	18.4	0.5	-	-	7.46
Line side L 60	30	-	-	219	36.5	0.5	-	-	6

TABLE 2 - 245 kV CIRCUIT BREAKERS

(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV

Fault duty	Current kA (rms)	First test voltage U1 (kV)	Time co-ord t1 (µs)	TRV peak value Uc (Kv)	Time co-ordt2 (µs)	Time delay td (µs)	Volt co-ord u' (kV)	Time co-ord t' (µs)	Rate of rise U'/t kV (kV/µs)
10% symmetrical	5	-	-	459	66	8	153	30	7.0
30% symmetrical	15	300	60	450	450	5(15)	150	35(45)	5.0
60% symmetrical	30	260	87	390	392	2(22)	130	45(65)	3.0
100% symmetrical	50	260	130	364	390	2	130	67	2.0
100%	**	260	130	364	390	2	130	67	2.0

asymmetrical									
Asynchronous	12.5	400	260	500	780	-	-	-	1.54
100% closing.	125	-	-	-	-	-	-	-	-

** Dependent on circuit breaker opening time

*** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with $t_{dl} = 0$

(B) SHORT LINE FAULT REQUIREMENTS

Source side	50	200	100	280	300	2	100	52	2.0
				U_L	**t_L**	**t_{dL}**			**U_L/t_L**
Line side L 90	45			32	3.6	0.5	-	-	8.9
Line side L 75	37 5			80	10.6	0.5	-		7 55
Line side L 60	30			128	21.3	0.5	-		6

TABLE 3 - 145 kV CIRCUIT BREAKERS

(A) TERMINAL FAULT REQUIREMENTS - FOUR PARAMETER TRV

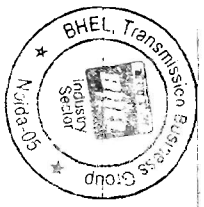
Fault duty	Current kA (rms)	First test voltage U1 (kV)	Time co-ord t1 (μs)	TRV peak value Uc (kV)	Time co-ordt2 (μs)	Time delay td (μs)	Volt co-ord u' (kV)	Time co-ord t' (μs)	Rate of rise U'/t kV (kV/μs)
10% symmetrical	4	-	-	272	45	6	91	21	6.0
30% symmetrical	12	178	36	266	270	5(9)	89	23(27)	5.0
60% symmetrical	24	178	59	266	266	2(15)	89	32(44)	3.0
100% symmetrical	40	178	89	249	267	2	89	46	2.0
100% asymmetrical	**	178	89	249	267	2	89	46	2.0
Asynchronous	10	296	178	370	534	-	-	-	1.67
100% closing	100	-	-	-	-	-	-	-	-

** Dependent on circuit breaker opening time

*** 100% Sym and Assym duties shall either include ITRVs of Table III of IEC 56 or the SLF duties have been performed with t_{dl} 0

(B) SHORT LINE FAULT REQUIREMENTS

Source side	40	118	59	166	177	2	59	32	2.0
				U_L	t_L	t_{dL}			U_L/t_L
Line side L90	36	-	-	18.9	2.6	0.2	-	-	7.3
Line side L75	30	-	-	47.4	7.9	0.2	-	-	6.0
Line side L60	24	-	-	75.9	15.8	0.2	-	-	4.8



Item No	Description		Particulars		
		kV	420	245	145
1	**MINIMUM FACTORS OF SAFETY FOR SWITCHGEAR**				
1.1	Complete insulators based on electro-mechanical test		2.5	2.5	2.5
1.2	Insulator metal fittings based on elastic limit		2.5	2.5	2.5

1.3	Steel structures based on elastic limit of tension members and on crippling loads of compression members		2.5	2.5	2.5
1.4	Foundations for structures against overturning or uprooting under maximum simultaneous working loadings		2.5	2.5	2.5

8. CLEARANCES*

8.1 Clearances for busbars and connections

RATED SYSTEM VOLTAGE kV					
		36	**145**	**245**	**420**
BIL	kVpK	170	650	1050	1425
SIL	kVpK	-	-	-	1050
Minimum Clearance between Live metal and Earth	m	0.32	1.3	2.0	3.4
Minimum Clearance between Live metal of Different Phases	m	0.43	1.5	2.4	3.9
Safety Working Clearance Horizontal	m	2.3	3.2	3.3	5.4
Safety Working Clearance Vertical	m	2.9	3.7	4.5	6.4
Minimum height to base of insulation	m	2.4	2.4	2.6	2.7

* Based on BS 7354: 1990

Clearances apply only to equipment not subject to impulse voltage type tests.

They apply to conditions of maximum conductor swing and sag.

Item	Description		Particulars		
9	**FINISH OF EQUIPMENT**				
9.1	**Outdoor equipment**		Outdoor	Outdoor	Outdoor
9.1.1	Porcelains		Brown	Brown	Brown
9.1.2	Structures		Hot dip galvanized		
9.1.3	Cubicles and enclosures		As	specified	
10	**LVAC EQUIPMENT**				
10.1	Rated system voltage	V	415V-30 240V-10	415V-30 240V-10	415V-30 240V-10
10.2	Rated frequency	Hz	50	50	50
10.3	Method of earthing system neutral		Solidly earthed		
10.4	Type of equipment required (switchfuses, MCCBs, air circuit breakers etc)		Air circuit breaker MCCBs		
10.5	Voltage limits for correct operation of circuit breakers	%V %	10 5	10 5	10 5
11	**DC AUXILIARY SUPPLIES**				
11.1	Nominal voltage of system	V	220	220	220
11.2	Voltage limits for correct operation of equipment	%	10 5	10 5	10 5
12	**NOMINAL VOLTAGE OF AUXILIARY SUPPLIES**				
12.1	Supply for electrical operation of circuit				

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	breakers				
12.1.1	Closing initiation	V dc	220	220	220
12.1.2	Tripping	V dc	220	220	220
12.2	Power supply for compressor equipment		415	415	415
12.3	Power supply for spring and hydraulic charging motors	V ac	240	240	240
12.4	Supply for indication and alarm circuits	V dc	220	220	220

ANNEXURE – I

(CIRCUIT BREAKERS)

CORONA, RIV AND SEISMIC TEST PROCEDURES

Corona and Radio Interference Voltage (RIV) test:

1) General:

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage(RIV).

2) Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3) Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Sub-Committee on Radio Interference Publication 1- 1972 second edition. The measuring circuit shall preferably be tuned to frequency of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used. The measuring frequency shall be recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be conducted in accordance with NEMA standard publication No. 107-1964 except as otherwise noted herein.

3.3 In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 metres of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurement. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipments unless otherwise specified

3.5 The metering instruments shall be as per CISPR recommendation or equipment device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a properly tuned noise meter

4.0 Test Methods for Visible Corona:

4.1 The purpose of this test is to determine the corona extinction voltage of apparatus and connectors, the test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset of extinction voltages, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. The voltage will then be decreased slowly until all visible corona disappears. The voltage will then be raised slowly again to the same maximum voltage The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e., 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two photographs shall be taken in each case.

4.2 The "test to determine the visible corona extinction voltage" need not be carried out simultaneously with "test to determine RIV levels". However, both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modifications or treatment of the sample between tests will be allowed Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of owner's inspector if, the same, in his opinion, will not prejudice other tests.

B. Seismic Withstand Test:

The seismic withstand test on the complete equipment shall be carried out along with the supporting structures etc. The seismic level specified shall be applied at the base of the structure The accelerometers shall be provided at the terminal pad of the equipment and any other point as agreed by the purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The detailed seismic test procedure shall be furnished for approval to the purchaser ,before offer for inspection.

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TECHNICAL SPECIFICATION

FOR

36 KV VACCUM CIRCUIT BREAKERS

(OUT DOOR TYPE)

TECHNICAL SPECIFICATION FOR 36 K.V. VACCUM CIRCUIT BREAKERS

(OUTDOOR TYPE)

1.1 SCOPE:

36 K.V. 1430 MVA (or as per data given) Circuit Breakers are intended to be purchased for installation at different Sub-stations. Some of the Sub-stations for which equipment are tendered are situated in coastal areas where saline climate prevails. The base structure of the circuit breakers must be galvanized.

1.2 POWER SUPPLY TO AUXILIARIES :

A.C. supply to auxiliaries will be 3 phase, 3 wire, 430 volt or single phase 250 volts at 50 C/s. The voltage variation will be within 10% and the frequency variation ± 5%.

1.03 33 K.V. CIRCUIT BREAKERS TYPE AND RATING :

The circuit breakers shall be vacuum type suitable for outdoor operation under the climatic conditions specified without any protection from sum and rain.

The circuit breaker shall have the following ratings :

1.	Number of poles	3 (One unit with three phase making and breaking).
2.	Frequency.	50 C/s.
3.	Nominal system voltage	33 KV rms.
4.	Highest system voltage	36.0 KV rms.
5.	Basic insulation level	170 KVP
6.	Power frequency test Voltage (wet)	75 KV (rms.)
7.	**Nominal Current.**	2000 Amps rms.
7a.	First pole to clear factor	1.5
8	Breaking capacity	
	(a) Symmetrical	25 KA/1430 MVA.
	(b)A symmetrical	33 kA Peak.
9.	Making capacity	62.5 KA Peak
10.	Continuous current rating	1600 Amps (RMS)

11. Operating Duty	:	0-0.3 Sec CO-3 Min-CO.
12.(a) Break time	:	3 Cycles
(b)Make time	:	5 Cycles.
(c)Minimum reclosing time		15 Cycle
(d)Minimum dead time for reclosing	:	15 Cycle
13. Dry one minute power frequency withstand test voltage		
a) Between line terminal	:	75 kV rms
b)Between line and body		75 KV rms.
14. Impulse withstand test voltage ;		
a)Between terminal with C.B. open.	:	170 KV (Peak)
b)Between body & terminal	:	170 KV (Peak)
15. Insulator or bushing		
a)Dry one minute power Frequency voltage,		75 KV
b)Wet one minute power Frequency withstand Voltage.	:	75 KV
c) Creepage distance		580 mm (Minimum)
16.Short time current rating for 3 seconds.		Not less than 25 KA for
17.Control circuit voltage	:	220 V D.C

1.04 **STANDARDS :**

The circuit breakers shall comply with the requirements of latest issue of IEC-62271-100,IEC-60694/IS12729:2004,IS-13118:1991, except wherein specified otherwise. Where the equipment offered confirm to any other standard the silent points of difference between the standard adopted and the IS or IEC recommendations shall be brought out in the tender. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above is also acceptable.

CLIMATIC CONDITIONS :

The climatic conditions at site under which the equipment shall be operated satisfactorily are as follows :

Peak ambient air temperature	:	50° C
Maximum temperature attainable by an object exposed to sun	:	60°C
Minimum temperature of the air in shade	:	0°C
Maximum yearly weighted average		32 C

ambient Temp.

Maximum daily average ambient temp	.	35deg C
Maximum humidity.		100%
Average number of thunder storm	.	70 Days per annum
Average number of rainy days per Annum		120
Average annual rainfall	.	1500 mm
Number of months of tropical Monsoon conditions per annum	:	4
Maximum wind pressure	.	260 kg/Sq.m.
Altitudes not exceeding.	:	1000 M

For the purpose of the specification, the limit of ambient temperature shall be50° C peak and 45° C average over a 24 hours period.

Some of the breakers to be purchased against this specification are intended to be installed on the sea coast having extremely saline climate. Necessary anti corrosive provisions need be incorporated.

1.5 **GENERAL** :

1.6 The circuit breakers shall be of vacuum type. The breakers shall be furnished as a complete unit with all accessories and equipment in place and all internal wiring installed and terminated in the mechanism.

1.7 The circuit breakers shall provide rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomena even under the most severe and persistent short circuit conditions or when interrupting small currents of leading or lagging reactive current. The details of any device incorporated to limit or control the rate of rise of restricting voltages across the circuit breaker contacts shall be stated The over voltages caused by the circuit breaker switching on inductive or capacitive load shall not exceed 2.5 times the normal phase to neutral voltage. The total break time for the circuit breakers throughout the range of their operating duty shall be stated in the tender and guaranteed

1.8 CONSTRUCTIONAL FEATURES :

Each circuit breaker shall comprise 3 identical poles complete with a gang operated mechanism for specified duty All these poles of the C.B. shall be linked together Electrically, Mechanically for specified duty

The breaker shall be capable of interruptions of low reactive current (lagging/leading) without undue over voltage and restrike

1.9 CONTROL CUBICLE :

A common control cubicle shall be furnished to house electrical controls monitoring devices and all other accessories. The cubicle shall be of gasketed weather proof construction,

fabricated from sheet **Aluminum alloy / Galvanizing iron sheet having minimum 3 mm thick. The operating mechanism shall be strong, rigid and not subject to rebound.**

1.10 The cubicle shall have front access door with lock and keys and removable gland plate at the bottom for owner's cable entry. Thermostat controlled space heater, internal illumination lamp, 5 A 3 pin socket with individual on off switches shall be provided in the cubicle.

1.11 **MOUNTING :**

The circuit breakers shall be suitable for mounting on steel galvanized structures. The prices of necessary frames for mounting the circuit breaker shall be included with the offer. A ladder should be provided in the structure for easy access to the operating mechanism house. The ladder shall be of M.S with hot dip galvanised

1.12 The circuit breakers shall consist of three identical single phase units with a common operating mechanism. All joints shall be welded so as to have adequate mechanical strength. The breaker porcelain shall be capable of withstanding all pressure resulting from any specified performance of the breaker.

The circuit breaker shall be supplied complete with the necessary lifting tools, foundation bolts and other accessories.

1.13 **TEMPERATURE RISE :**

The maximum temperature attained by any part of the equipment when in-service at site under continuous full load conditions and exposed to direct rays of sun shall not exceed the permissible limits fixed by approved specifications. When the standards specifies the limits of temperature rise these shall not exceed when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specification. The corrections proposed shall be stated in the tender and shall be subject to approval of the purchaser.

1.14 **INSULATION OF THE CIRCUIT BREAKERS :**

1.15 The insulation to ground, the insulation between open contacts, the insulation between phases of the completely assembled circuit breakers, should be capable of withstanding satisfactorily die-electric test voltages corresponding to basic insulation level specified in clause-1.03.

1.16 The clearance in open air shall be as follows, unless the apparatus is impulse tested after complete assembly.

i)	Minimum clearance between phase :	505 mm
ii)	Phase to Earth :	305 mm
iii)	Minimum clearance between live Parts and grounded objects.	1400 mm
iv)	Minimum ground clearance to live	3700 mm

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part.

Note: The clearance as above. Or as per the type tested CB in line with the relevant IEC for most polluted climatic condition.

1.17 BUSHING AND INSULATIONS :

The basic insulation level of the insulating porcelains shall be as specified and shall be suitable for installation in contaminated atmospheres. The porcelains used shall be homogenous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. The puncture strength of the bushings shall be greater than the flashover value. The bushings shall be entirely free from radio disturbance when operating at a voltage 10% above rated voltage and also be free from external corona.

Adequate means shall be provided to accommodate conductor expansion and there should not be any undue stressing of any part due to temperature change

1.12 **OPERATION MECHANISM :**

1.12.1 The operating mechanism shall be spring operated type In case of spring operating mechanism it shall be of motor operated having provision of hand operated spring charging type of by local/remote electric control under normal operation The mechanism shall be trip from electrically and mechanically. All working parts in the mechanisms shall be corrosion resistant material and all bearings which require greasing shall be equipped with pressure grease fittings. The mechanism shall be strong, positive, quick in action and shall be removable without disturbing the other parts of the circuit breakers. The mechanisms of breaker shall be such that the failure of any spring will not prevent tripping.

1.12.2 The operating mechanism along with its accessories shall be mounted in a weather proof cabinet with hinged doors located near the breakers. A local control switch and the breaker position indicator shall be provided in the cabinet The circuit breakers shall also be provided with means for manual operation for maintenance purposes.

1.12.3 The control circuits shall be designed to operate on 220V. d.c. It shall be possible to adopt to work on other voltages by simply changing the operating coils. The closing and operating coils shall be designed to operate satisfactorily at any control voltage from 70% to 115% of the normal rated voltage. A heater shall be provided in the cabinet to prevent moisture condensation.

1 12.4 Necessary cable glands for the cables of the operating mechanism shall be provided

1.12.5 All the terminal blocks to be used in the operating mechanism should be of stud type of Poly-amide/Melamine material of make like Elmex (OAT-6 for non-disconnecting type and OAT 6T for disconnecting type) / WAGO/ Connectwell (Equivalent).

1.12.6 The Motor to be used for spring charging shall be of Universal type and suitable for AC and DC supply(220 V DC).

1.13 **TERMINAL CONNECTORS** :

Technical connectors suitable for all ACSR Moose/ACSR Zebra Conductor (as per the provision laid down) shall be provided, Suitable terminal earth connector for earthling connections shall also be supplied.

1.14 AUXILIARY SWITCHES :

Spare 10 Nos N O (normally open) & 10 Nos N/C (normally closed) of auxiliary switches (contacts) shall be provided on each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking etc. Special contact for use with trip coil and single short reclosing operation which permits relative adjustment with respect to the travel of the moving contact of the circuit breaker shall also be provided. There shall be provision to add more auxiliary switches at the later date if required

1.15 **COMPLETENESS OF EQUIPMENT** :

Any fittings, accessories or apparatus which may not have been specifically mentioned in those specification but which are usual or necessary in the equipment of similar plant shall be deemed to be included in the contract and shall be supplied by the contractor without extra charges. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not. The detail bill of materials list to the furnished along with the tender.

1.16 **AFTER SALES SERVICE** :

1.16.1 The supplier should guarantee for after sales service for a minimum period of one and half years from the date of receipt of the equipment or one year from the date of commissioning of the equipment whichever is earlier.

1.16.2 The supplier also should guarantee after sales service beyond the free service period

1.16.3 Supplier also should provide after sales service within 15 days of receipt of intimation from the field Engineer-in-charge of the equipment or the purchaser.

1.16.4 COMMISSIONING :

The manufacturers shall render all help for commissioning of the breakers. Supervision of erection , testing & Commissioning charges per breaker to be quoted in the schedule of prices (Annexure-v) for evaluation of the Price bid or else it will be presumed that the charges towards Supervision of erection , testing & Commissioning per Breaker are included in the unit price offered.

1.17 EXPERIENCE :

The list of supplies already made by the supplier/manufacturers are to be enclosed along with the tenders.

1.18 RECOMMENDED SPARES AND TOOLS :

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For 5 (five) years operation, price are to be enclosed along with the tenders for each item of spares and special tools.

2.0 **TEST :**

2.1 Type test : - All the equipment offered shall be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested in an Govt. Approved test Laboratory, the bidder shall furnish four sets of type test reports along with the offer. These tests **must not have been conducted earlier than ten years from the date of opening of bids**. The purchaser reserves the right to demand repetition of some or all the type tests in the presence of owner's representative. For this purpose the bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type offered against this specification, if accepted by the purchaser, the purchaser reserves the right to demand repetition of tests without any extra cost. Reports of Type tests as stipulated in relevant IS along with Impulse and short circuit test documents conducted shall be supplied along with the tender. All the test reports should be submitted and shall be approved by the purchaser before dispatch of the material

Note :- Drawings in the tender not accompanying with the type test reports along with Impulse and short circuit tests are liable for rejection.

Type Tests:--(As per IEC-62271-100)

1) Dielectric Test(LI Voltage,PF Voltage Withstand(Dry&Wet)& etc)

2) RIV Test

3) Measurement of resistance of the main circuit

4) Temperature rise Test

5)Basic short circuit duty test ,Short Time withstand current & Peak withstand current Test

6) Mechanical Operation Test, Mechanical endurance test

7)Out of phase / Short Circuit making & Breaking Test

8) Capacitive Current, Switching Test ,a) cable charging current Test b)Single capacitor Bank current switching test

9)Test to verify degree of protection

Routine Tests:-

1)Dielectric Tests on the main Circuit ,auxiliary & control circuits

2)Measurement of resistance of the main circuit.

3) Design & Visual Checks(Dimensions,clearances&etc)

4) Mechanical operation Test

5) Operating time of the device, motor Characteristics, measurement of coil current & resistance , Sf6 gas pressure monitoring ,electrical scheme,control Circuit,anti-pumping, vaccum interrupter(type,make&etc),dimensions, name plate details , contact travel & timing checks .

Acceptance and Routine Tests.

2.1.1 All acceptance and routine tests as stipulated in the relevant standards & above shall be carried out by the supplier in presence of owner's representative

2.1.2 Immediately after finalization of the programme of type/acceptance/routine testing, the supplier shall give twenty days advance intimation to the purchaser, along with the shop routine test certificate and valid calibration certificates of the equipments/instruments calibrated in a govt. approved test house ,to be used during testing for scrutiny,to enable him to depute his representative for witnessing the tests.

3.0 **INSPECTION :**The inspection may be carried out by the purchaser at any stage of manufacture. The successful tendered shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipments under this specification by the purchaser, shall not relieve the supplier in his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

4.0 **QUALITY ASSURANCE PLAN** :

4.1 The tenderer shall invariably furnish following information along with his offer, failing which his offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered

(i) Statement giving list of important raw materials names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested List of tests normally carried out on raw materials in presence of tenderer's representative, copies of test certificates.

(ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

(iii) List of manufacturing facilities available

(iv) Level of automation achieved and list of areas where manual processing exists.

(v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

(vi) Special features provided in the equipment to make it maintenance free.

(vii) List of testing equipments available with the tenderer for final testing of equipment specified and test plant limitation. If any, vis-avis the type, special acceptance and routine tests specified in the relevant standard. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

4.2 The successful tendered shall within 30 days of placement of order, submit following information to the purchaser.

(i) List of raw materials as well as bought out accessories and the names of sub suppliers selected from those furnished along with offer

(ii) Type test certificates of the raw material and bought out accessories.

(iii) Quality assurance plan (QAP) with hold points for purchaser's inspection. The quality assurance plan and purchasers hold points shall be discussed between the purchaser and supplier before the QAP is finalized.

4.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material viz. oil, copper, aluminum, conductors, insulating materials, core material at the time of routine testing of the fully assembled equipment.

4.4 **DOCUMENTATION :**

All drawing shall conform to International Standards organization (ISO). A series of drawing sheet/Indian standards specification IS.656. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

4.5 List of drawings and documents.

The bidder shall furnish four sets of following drawings along with his offer.

a) General outline and assembly drawings of the equipment.

b) Graphs showing the performance of equipment

c) Sectional views showing :-

i) General Constructional features.

ii) The materials/gaskets/sealing used

iii) method of connections.

iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.

d) Arrangement of terminal's and details of connection studs provided

e) Name Plate

f) Schematic drawing :-

g) Type test reports in case the equipment has already been type tested.

h) Test reports, literature, pamphlets of the bought out items, and raw material.

4.6 The successful tender shall, within 2 weeks of placement of order, submit four sets of final version of all above said drawings for purchaser's approval. The purchaser shall communicate his comments/ approval on the drawings to the supplier within four weeks. The supplier shall, if necessary modify the drawings and resubmit three copies of the modified drawings for owner's approval within two weeks from the date of owner's comments. After receipt of owner's approval, the supplier shall within two weeks, submit. 15 prints and two good quality reproducible of the approved drawings for purchaser's use.

4.7 One set of the type test reports, duly approved by the purchaser, shall be submitted by the supplier for distribution before commencement of supply. Adequate copies of acceptance and routine test certificates, duly approved by the purchaser, shall accompany the dispatched consignment.

4.8 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

4.9 5 sets of nicely printed and bound volumes of operation, maintenance and erection manuals in English language for each type and rating of equipment supplied shall be submitted by the supplier for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipment. The manual shall also contain a set of all the approved drawings, type test reports etc

4.10 Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering design workmanship & latest revisions of relevant standards at the time of ordering &purchaser shall have the power to reject any work or materials which in his judgment is not in full accordance therewith

5 PACKING AND FORWARDING

5.1 The equipment shall be packed in crates suitable for vertical/horizontal transport as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for

lifting, such as lifting books etc shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

5.2 Each consignment shall be accompanied with a detailed packing list containing the following information.

a)Name of the consignee

Details of consignment

Destination

Total weight of consignment.

Sign showing upper / lower side of the crate.

Handling and unpacking instructions.

Bill of material indicating contents of each package.

The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

TOPOGRAPHICAL AND METEOROLOGICAL SITE CONDITIONS

Location of installations	State of ODISHA
Altitude	1000 m
Maximum Temperature	60°C
Minimum Temperature	0°C
Maximum daily average temperature	35°C
Maximum humidity 100%	
Pollution level	Heavy
Airborne contamination, if any	Highly Polluted
Seismic withstand factor	0.3 g
Maximum wind pressure	260 kg/m²
Wind velocity	50m/sec
Maximum rainfall per annum	2000 mm
Average rainfall per annum	1500 mm
Average no. of thunder storm days/annum	70
Average no. of dust storm days per annum	20

GUARANTEED TECHNICAL PARTICULARS FOR CIRCUIT BREAKERS

(To be filled in & furnished by the Bidder , separately for 420 Kv, 245 KV & 145 KV SF6 Circuit Breakers)

(a)Maker's name and country of manufacture

(b) Manufacturer's type Designation

2. Applicable technical standards

3. (a)Rated voltage(kV)

(b)Rated frequency(Hz)

4 Number of Poles

5. Class

6. Rated normal current

(a) Under site conditions(Amps)

(b) Rated (Amps)

7. (a) Rated short circuit breaking current

(i) Rms value of AC component of rated short circuit current (KA)

(ii)Percentage DC component

(iii)Assymetrical Breaking Current at Highest System Voltage

(iv)Certificate or report no

(v)Oscillogram no.

(b)Rated short circuit making current (KA peak)

(i)At Higher rated Voltage

(ii)At Lower rated Voltage

(c) Maximum Breaking capacity Under Phase Opposition(KAP)

(i)Max Pole discrepancy(ms)

(ii)Max arc duration & Corresponding current under lockout pressure

Annexure A

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8. First pole to clear factor

9. Rated transient recovery voltage for terminal faults

(kV peak)

10. Rated characteristics for short line faults.

11. Rated operating sequence

12. Rated duration of short circuit(Sec.)

13. Rated out of phase making & breaking current (kA)

14. (a) Opening time (ms)

(i) Maximum Opening time under any condition

(ii) With limiting Voltage & Pressure.

(b) Arcing time (ms)

(i) At 100% rated breaking current (ms)

(ii) At 50% rated breaking current (ms)

(iii) At 25% rated breaking current (ms)

(iv) At 10% rated breaking current (ms)

(v) Maximum arcing time at lowest

fault current (ms).

(c) Break Time (ms)

(i) At 100% rated breaking current (ms)

(ii) At 50% rated breaking current (ms)

(iii) At 25% rated breaking current (ms)

(iv) At 10% rated breaking current (ms)

(v) Maximum break time at lowestfault current (ms).

(i) Maximum Total Break Time under any duty condition

For any current up to rated breaking current with limiting condition of Voltage & Pressure(ms)

(d) Closing time (ms)

Annexure A

(e) Minimum dead time for 3 phase reclosing

(f) Maximum Close Open Time under any condition

With limiting Voltage & Pressure

(g) Minimum Time Interval between each make/ Break Operation.

15. Rated line charging breaking current (kA)

16. Rated small inductive breaking current (kA)

17. (i)Max. rise of temperature over ambient for

current rating under sl. 6.

(ii)Max. rise of temperature for

Main contacts over design ambient temperature of 50deg C.

18. Interrupting capacity based on duty cycle as per sl. 11.

(a) AC ;component (kA)

(b) Percentage DC component.

19. Latching current (kA)

20. No. of breaks in series per pole.

21. Length of contact travel (mm)

22. Total length of break per pole (mm)

23. Rate of contact travel:

(a) At tripping (metres/sec.)

(b) At closing (metres/sec.)

24. Type of devices, if any, used to obtain

uniform voltage distribution between breaks.

25. Recovery voltage distribution between

breaks in percent of rated voltage

(a) Single line to ground fault

(b) Interruption on short lines.

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Annexure A

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(c) Switching off an unloaded, transformer

26. (i) Type of main contact.

(i) Number of auxiliary contacts per pole for normal operation(NO & NC)

(ii) Number of auxiliary contacts per pole provided for Owner's use(NO & NC)

(iii) Current rating of Auxiliary contacts

27 Type of arcing-contacts and/or arc

control device

28. Material of contacts:

i. Main

ii. Arcing

iii. Whether contacts are silver plated

iv. Thickness of silver coating mm

v Contact pressure, kg/sq. mm.

29. Insulation level of the breaker:

(a) 1 minute power frequency withstand

voltage kV rms(Dry & Wet)

(i) Between live terminals & Ground

(ii) Between terminals with Breaker contacts open

(a) Switching surge withstand test

Voltage kV (peak)

- To earth

-Across open contacts

(c) Lightning impulse withstand test voltage, kV(peak)

- To earth

- Across open contacts

(d) Max dynamic power frequency over voltage

withstand kV (peak)

Annexure A

30. i) RIV level (Max)

(viii) Corona inception voltage (kV rms)

(ix) Corona extinction voltage (kV rms)

31. Minimum clearances

(a) Between phases (live parts)(mm)

(b) Between live parts and earth (mm)

(c) Total Creepage Distance

(i) To ground (ii) Between Terminals

32. Whether the circuit breaker is fixed trip or trip free

33. Method of closing

(a) Normal

(b) Emergency

34. Type of closing mechanism

35. (a) Normal voltage of closing

(b) Pick up range (volts DC)

36. (a) Power at normal voltage of closing mechanism (watts)

(b) Power at 85% of normal voltage of closing mechanism(watts)

(c) No of closing coils in operation

37. Type of tripping mechanism

Number of Tripping Coil

38. (A) Normal voltage of tripping coils(volts)

(a) Power at normal voltage for Tripping coils (watts)

(b) Power at 70% normal voltage for Tripping coils (watts).

(c) No. of tripping coils in operation

(d) Pick up range (V DC)

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(B) Number of close open operation

(i) possible after failure of AC supply to motor

(ii) Time required for motor to charge the closing spring(Sec)

(iii) Whether indication of spring charged condition will be provided in control cabinet.

39. Arc duration at 100% (ms)

40. Interruption capacity:

2 Opening

Arcing time no. of loops and time including resistor current duration (cycle)

Resistor current duration (cycle)

Total length of the arc (mm)

Max. length of the arc (mm)

Total interrupting time measured from instant of trip coil energization to arc extinction of resistor current (cycles)

3 Closing time measured from instant of application of power to closing device upto arcing contacts touchings (cycles)

41 Critical current (current giving the longest arc when a break takes place) (kA)

a) Recovery voltage when circuit breaker tested at 100% rated breaking capacity (kV inst.)

b) Rate of rise of restriking voltage at breaking

i) for 30% breaking capacity (kV/microsecs.)

ii) for 100% breaking capacity (kV/microsecs.)

c) Maximum over-voltage factor of the circuit breaker when switching off.

i) Unloaded transformers

ii) Loaded transformer

iii)Open circuited lines

Annexure A

42. When switching of synchronous systems:

(a) Max. current (kA)

(b) Max. contacts of 1 pole (kV)

43. No. of openings the circuit breaker is capable of performing without inspection, replacement of contacts or other main parts.

(a) at 50% rated current

(b) at 100% rated current

(c) at current corresponding to 50% rated breaking capacity.

(d) at current corresponding to 100% rated breaking capacity.

44. (A)a) Weight of complete circuit breaker (Kg).

b) Impact loading for foundation design, to include deed load plus impact value on opening at maximum interrupting ratings, in terms of equivalent static load (Kg.)

c) Overall dimensions:

Height (mm)

Width (mm)

Length (mm)

(B) Type & Material of Gasket used to ensure gas tight joints for

(i)Metal to Metal Joint

(ii) Metal to Porcelain Joints

(C) Type & Make of

a) Density Monitor

b)Pressure Gauge

(D) Density Monitor Setting

a) Lock Out

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b) Alarm

45. Porcelain:

i) Make

j) Type

k) Descriptive pamphlet no.

l) Weight (kg.)

m) Transport dimensions (mm)

n) Height above floor, required to remove porcelain (mm).

o) Insulation class

p) One minute power frequency withstand, kV (rms) (dry & wet)

q) Flash over voltage (kV)

r) Lightning impulse withstand voltage kV (peak) (dry & wet)

s) Switching surge withstand voltage kV (peak) (wet)

t) Corona discharge voltage (kV rms)

u) Creepage distance, total protected (mm)

v) Permissible safe cantilever loading on installed porcelain (Kg.m)

46. (i)Rated pressure of SF6 gas in the circuit breaker (Kg/sq.cm)

(ii) Rated Pressure of SF6 in operating Chamber(kg/cm2) at 20deg C

(iii) Limits of Pressure of extinguishing medium

47. Rated pressure of SF6 gas in the gas cylinders (Kg/sq.cm)

48. (i)Quantity of SF6 gas required per single pole unit (Kg.) at rated Pressure & at 20 deg C

(ii) Guaranteed Maximum Leakage rate per Year.

49. Quantity of SF6 gas per cylinder (Kg.)

Standard to which SF6 Gas Complies.

(i) Weight of empty cylinder (Kg.)

(ii) Whether Breakers are dispatched filled with SF6 Gas or filled at site

Annexure A

Quantity of absorbent required per pole (Kg.)52.

Recommended interval for renewal of absorbent in case of outdoor circuit breakers operating in tropical conditions.

iv) Chemical composition of absorbent

v) Quantity of absorbent covered in the scope of supply

(Including spare quantities)

vi) Limits of gas pressure for pressure operation of circuit breaker – (Kg/sq.cm)

vii) Pressure and temperature at which the temperature compensated gas pressure switch will

a) give alarm (Kg/sq.cm., deg. C)

b) cut off (Kg/sq.cm. deg. C)

viii) Name of SF6 supplier and country of origin.

ix) Quantity of SF6 gas supplied for

a) Actual use in breakers (Kg.)

b) As spare (Kg.)

x) Chemical composition of gas:

a) Qty. of air by weight (ppm)

b) Qty. of H_2O by weight (ppm)

c) Qty. of CF_4 by weight (ppm)

d) Qty. of free acid by weight (ppm)

e) Density

f) Oil Content

g) Resistivity

xi) Motor For Circuit Breaker

(a) Manufacture's name & address

(b) Eqipment driven by motor or not.

(c) Motor Type

(d) Country of Origin

(e) Type of Duty

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(f) Type of Enclosure & Method of Cooling

(g) Applicable Standard to which motor confirms

(h) Type of mounting

(i) Direction of rotations as viewed from non driving end.

(j) Standard Continuous rating at 50deg C

(k) Rated Voltage

(l) Rated Speed at rated Voltage & Frequency(rpm).

(m) Full Load current at rated voltage & frequency.

(n) Power Factor at rated load.

(o) Rating of the Motor.

(p) Time for fully charging the closing spring

xii) Control Cabinet

i. Material of enclosure

ii. Thickness of sheet steel

iii. Painting for control cubicle

iv. Paint shade

v. Degree of protection

vi. Dimension

vii. Material of gasket

Name of the firm.. ..... Signature of Bidder.....

Designation & Seal ..... Date .....

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SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 36 KV CIRCUIT BREAKERS

1 Name of Manufacturer.

2 Manufacturer's type designation

3. Rated Voltage. - KV

4 Maximum (continuous) service rated Voltage - KV

5. Normal current rating.

a) Under normal conditions.

b) Under site conditions.

6. Short time current rating for seconds (rms)

7. Maximum temperature rise over ambient. -°C

8. Breaking capacity.

a) Symmetrical. KVA

b) Assymmetrical. MVA

9. Making capacity. KA

10. Total break time in ms.

a) at 10% rated interrupting capacity - MS

b) at rated interrupting capacity - MS

11.Arcing time. - M.S.

12. Make time. - M.S.

13. Minimum reclosing time at full rated - M.S.

Interrupting MVA from the instant of Trip coil energization.

14 Minimum dead time for 3 phase reclosing.- M.S.

15. Whether restricting free. Yes/No

16. One minute dry power frequency

Withstanding test voltage (KV rms)

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Between line terminal and ground objects. KV rms.

Between terminal with breaker contacts open. KV rms.

17. 1.2/50micros full wave impulse withstand test voltage for the two cases above.

i) Between line terminal & grounded objects. KV(Peak)

ii) Between terminal with breaker Contacts open.

18. **Busing or Insulators :**

i) Type of bushing. -

ii) Dry 1 minute power frequency - KV rms

withstand test voltage.

iii) Dry flashover value. - KV rms.

iv) Wet flashover value. - KV rms.

V) 1.2/50 impulse withstand - KV(Peak)

vi) Creepage distance. - mm

vii) Puncture value of bushing. - KV

viii) Weight of bushing. - Kg.

19. Minimum clearance in air.

i) Between phases. - mm

ii) Live parts to earth. - mm

iii) Live parts to ground level - mm

iv) Between live parts & grounded object mm

20. Number of poles of circuit breaker.

21. Number of breaks per phase.

22. Total length of break per phase.

23. Type of main contacts.

24. Type of Aux. Contacts.

25. Materials of auxiliary contacts.

26. Contacts silver plated or not.

27. Thickness of silver plating.

28. Contact pressure.

29. Voltage distribution between breaker

30. Type of device if any, used to limit

the rate of rise or restricting voltage

31. Voltage grading device if any used

32. Number of auxiliary contacts provided

i) Those closed when breaker is closed.

ii) These open when breaker is closed

iii) Those adjustable with respect to the position of main contacts.

33. Type of operating mechanism

i) Openning

ii) Closing.

34. Control circuit voltage

35. Power required for trip coil Watts

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at 220V D.C.

36. Power required for close coil
At 220V D.C. - Watts

37 Frequency at which contacts are
To be replaced.

38. Nos. of terminal connector.

39 Steel support structure galvanized - Whether
With foundation – Nuts & Bolts to be provided yes or no

40. Type test certificate Furnished - Yes/No

41 Circuit Breaker weight. - Kg.

42. Quantity. - Nos.

Name of the Firm:-

Signature of the bidder:-

Designation & seal:-

Date:-

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3.2.10 EHV-POWER CABLE CONNECTION

1. General

The design of the cable end box shall fully comply with the IEC 62271-209 standard. The Extra high voltage power cables, shall be supplied by the tenderer. The type and size of cables shall be as per requirement. The final connection of the high voltage cable circuits in the GIS will be by means of individual single-phase cables, with one cable per phase.

The cable end unit design shall include a facility for high voltage AC testing of the connected power cable on site. Removable bolted links or similar connections will be accepted. The design of the link and connections shall ensure that when removed the resulting gap can withstand the impulse and power frequency test voltages applicable to the switchgear and the cable high voltage AC test voltage.

2. Interface definition

Dimensions and division of work shall fully comply with IEC 62271-209 standard.

Note: The details of the XLPE cable to be estimated based on the layout during detailed engineering.

3.2.11 LOCAL CONTROL CUBICLE (STAND ALONE TYPE FOR 420 KV & 245 KV and INTEGRATED TYPE FOR 145 KV):

1. General

1.1 One local control cabinet (LCC) shall be supplied for the local control and operation of each circuit breaker bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS feeder bay.

The LCC shall operate as a link between GIS and Control, protection and substation automation system (SAS) in Control Room LCC shall generally include:

- mimic showing the single line diagram showing the position of CB, Dis, FAES, MES etc.
- Position indicators of CB, Dis, FAES, MES etc.
- Discrepancy type control switches for breaker, disconnector and earthing switch
- Local / remote selections
- Alarm and indication devices.
- Aux. relays or other devices as required by the design.

For easy overview, the LCC's should be stand-alone type for 420 KV & 245 KV and Integrated type for 145 KV in the switchgear in front of the related circuit breaker bay. A general arrangement drawing showing the installation position shall be submitted with the quotation.

The LCC's shall be installed indoors. The LCC's shall also be dust and vermin proof and shall be located near GIS modules.

The control and operation circuits shall be well shielded and with safety measures to protect operator from touching energized parts. Power frequency withstand of control circuits shall be 2 kV for 1 minute. The LCC shall be factory tested and shipped together with the bay as one transport unit.

1.2 CONTROLLED SWITCHING DEVICE: CSD: IEC: 60255.

Circuit Breaker Panel shall be equipped with controlled switching device for controlled switching operation of CB. The CSD shall be provided in the 400kV Circuit breakers for controlling transformers and reactors (i.e. for breakers of switchable line reactor and in Main & Tie circuit breakers of Transformers, Transmission lines with non-switchable line reactors and Bus reactors).
Note: The requirement of CSD shall be explicitly specified in price schedule

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Technical Requirement for Controlled switching device:

a) The CSD shall be designed to operate correctly and satisfactorily.

b) The CSD shall meet the requirements of IEC-61000-4 16 class IV regarding HF disturbance test and fast transient test shall be as per IEC-61000 – 4-4 level IV and insulation test as per 60255 – 5.

c) The CSD shall have functions for switching ON & OFF the circuit breakers.

d) The CSD shall get command to operate the breakers manually or through auto reclose relay at random. The controller shall be able to analyse the current and voltage waves available through the signals from secondaries of CTs & CVTs/VTs for the purpose of calculation of optimum moment of the switching of the circuit breaker and issue command to circuit breaker to operate.

e) The CSD shall have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command. In calculation of net operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker such as, but not limited to, ambient temperature, control voltage variation, SF6 gas density variations etc. Schematic drawing for this purpose shall be provided by the contractor. The accuracy of the operating time estimation by the controller shall be better than + 0.5 ms.

f) The CSD shall have communication port to facilitate online communication of the control switching device with SCADA directly on 61850.

g) The CSD shall be PC compatible for the setting of various parameters and downloading of the settings and measured values date time of switching etc. Window based software for this purpose shall be supplied by the contractor to be used on the owner's PC.

h) The CSD shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs/VTs. The controller shall withstand transient and dynamic state values of the current from the secondary of the CTs and CVTs/VTs.

i) The CSD shall have time setting resolution of 0.1 ms or better.

j) The CSD shall have sufficient number of output/input potential free contacts for connecting the monitoring equipment and annunciation system available in the control room. Necessary details shall be worked out during engineering the scheme.

k) The CSD shall also record and monitor the switching operations and adjust the switching instants to optimize the switching behaviour as necessary. It shall provide self-diagnostic facilities, signalling of alarms and enable downloading of data captured from the switching events.

l) The provision for bypassing the Controlled switching device shall be provided through BCU and SCADA both so that whenever, the CSD is not healthy due to any reason (including auxiliary supply failure), uncontrolled trip/close command can be extended to the circuit Breaker. Alternatively, in case of any non-operation of the

CSD after receiving a close/trip command after a pre-determined time delay, the CSD should automatically be bypassed to ensure that the trip and close commands are extended to the Trip/Close coils through subsequent command.

m) The CSD shall be provided with a communication port to facilitate online communication of the CSD with Substation automation system (SAS) directly on IEC 61850 protocols. If the CSD does not meet the protocols of IEC 61850, suitable gateway shall be provided to enable the communication of CSD as per IEC 61850.

n) The CSD shall Store enough data (a minimum of 1000 nos.) the event records for further analysis.

o) The CSD Shall be compliant with Cybersecurity standard IEC 62443.

p) The CSD Shall be type tested as per EN / IEC 61000-4-16 class IV for HF disturbance test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz (for short and continuous duration both); EN / IEC 61000-4-4, LEVEL IV for fast transient/burst immunity test and as per EN / IEC60255-5 or EN / IEC 60255-27 for insulation test.

q) Any other requirement other than above as required for the CSD shall also include for smooth operation.

2. DC Supplies and Circuits

DC supplies shall be provided by the tenderer for all control, interlocking, alarm, indication and power supply circuits. The normal maximum and minimum voltage levels that will occur on the supply are specified.

SECTION-3

Refer document

General Technical Requirements: TB-420-316-XXX Rev 00.

Refer Duburi Project Only

SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)
b)	Engineer/Consultant/ Inspector	-
c)	Project Title	2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI
d)	Project Location	**400/220kV GIS S/S** Place: Erasama, Paradeep District: Jagatsingha State: Odisha **400kV AIS S/S Bay Extn.** Place: Duburi District: Jajpur State: Odisha
e)	Latitude & Longitude	**400/220kV GIS S/S** North: 20°12'32" and East: 86°21'44" **400kV AIS S/S Bay Extn.** North: 20°56'14" and East: 86°00'23"
f)	Nearest Railway Station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
g)	Distance of project location from the Railway station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
h)	Nearest Major Town	Bhubaneswar
i)	Distance of the town from the project site	86 Km from Erasama & 120 Km from Duburi
j)	Nearest commercial airport	Biju Patnaik International Airport, Bhubaneswar

k)	Distance of airport from the project site	86 Km from Erasama & 120 Km from Duburi
	SITE CONDITIONS (for design purposes)	
a)	Annual mean if maximum monthly average temperature	50°C
b)	Annual mean if minimum monthly temperature	5°C
c)	Design ambient temperature	50°C
d)	Average Rainfall in mm	1500 mm
e)	Average thunderstorm days per year	77 days
f)	Maximum Relative humidity	100 %
g)	Average Relative humidity	85 %
h)	Height above mean sea level	Less than 1000 meters
i)	Pollution Severity	Heavily polluted
j)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
k)	Basic Wind speed "Vb" at ten meters above the mean ground level.	55m/ sec for Erasama 50 m/ sec for Duburi
l)	Risk Coefficient "K1"	1
m)	Seismic Co-efficient	0.06g Horizontal 0.01g Vertical

3.1.1 SYSTEM PARAMETERS

Sl.No.	Parameters	**400 kV**	**220 kV**	**33 kV**
1	Highest system voltage	420 kV rms	245 kVrms	36
2	System Frequency	50 Hz		
3	Variation in Frequency	+ - 2.5 %		
5	Lightning Impulse voltage	±1425kVp	± 1050kVp	170
6	Switching impulse voltage	±1050kVp	-	
7	Power frequency withstand for 1 min (rms)	630 kV (rms)	460 kV (rms)	70 kV (rms)
8	Max. fault level (3/1 sec.)	63 kA	50kA	31.5kA
9	Minimum creepage distance	13020 mm (Erasama) 10500 mm (Duburi)	7595mm (Erasama) -	1116mm (Ersama) 900mm (Duburi)
10	System Neutral Earthing	Effectively Earthed		
11	Corona Extinction Voltage	320kV	156kV	-
12	Radio Interference Voltage	500µV at 266kV	500µV at 167kV	-

3.1.2 AUXILIARY POWER

Nominal Voltage V	**Variation**	**Frequency Hz or DC**	**Phase**	**Wires**	**Neutral Connection**
430	±10%	50±5%	3	4	Solidly earthed
240	±10%	50±5%	1	2	Solidly earthed
220	187V - 242V	DC	DC	2	Isolated 2 wires
50	45V - 55V	DC	DC	2	+ve earthed

3.1.3 The minimum electrical clearances for 400/220/33kV switchyard shall be as given below:

	400kV	**220kV**	**33kV**
Phase to earth clearance	3400 mm	2160mm	320mm
Phase to phase clearance	3900 mm	2160mm	320mm
Section clearance	6500 mm	5000mm	3000mm
Ground Clearance	8000 mm	5500mm	4000mm

3.2 INSTRUCTION TO BIDDERS:

The bidders shall furnish technical data sheets, catalogues, engineering data, technical information, design documents, drawings etc. fully in conformity with the technical specification.

The supplier should be approved by Employer (OPTCL). If not, it is the responsibility of the vendor to be assessed and approved by Employer, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Purchaser. Sufficient amount of information for justifying such proposals shall be furnished to Purchaser along with the bid to enable the Purchaser to determine the acceptability of these proposals.

Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood to be indicative of the function and quality desired and not restrictive. Other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed.

Except where otherwise specified or implied, the bidder shall comply with the latest edition of the relevant Indian Standards, International Electrotechnical Commission (IEC) standards and any other standards mentioned in this Specification. The Bidder may submit for approval, equipment or materials conforming to technically equivalent National Standards. In such cases copies of the relevant Standards or part thereof, in the English language shall be submitted with the Tender.

In case of conflict the order of precedence shall be (1) IEC, (2) IS and (3) other alternative standard.

Reference to a particular standard or recommendation in this Specification does not relieve the Bidder of the necessity of providing the Contract Works complying with other relevant standards or recommendations.

The list of standards provided in the schedules of this Specification is not to be considered exhaustive and the Bidder shall ensure that equipment supplied under this contract meets the requirements of the relevant standard whether or not it is mentioned therein.

Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

3.4 LANGUAGE AND SYSTEM OF UNITS

The English language shall be used in all written communications between the Employer, the BHEL/OPTCL and the Bidder with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Bidder pertaining to the work, unless otherwise agreed by the Employer.

It is required that danger plates, equipment designation labels or plates, instruction notices on plant and general substation notices be written in English, Hindi and Oriya. Control switch and lamp labels, indicator lamp and annunciator inscriptions shall be in English only.

The Bidder must furnish a schedule giving the English, Hindi and Oriya version of all labels, notices, etc., for approval.

The design features of all equipment shall be based on the SI system of units.

3.5 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

3.6 CORRESPONDENCE, DRAWINGS, APPROVAL PROCEDURE AND SAMPLES

3.6.1 Drawings & Document Submission

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the bidder (including those of sub-vendors) shall bear project specific title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

All dimensions marked on drawings shall be considered correct although measurement by scale may differ from general arrangement drawings. Detailed drawings shall be worked to where they differ from general arrangement drawings.

All drawings for approval shall have the OPTCL-LOGO and the name of the Employer.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

The review of these document/data/drawings by the purchaser will cover only general conformance of the document/data/drawings to the specification and contract, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the purchaser shall not be considered by the bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. Approval of bidder’s drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

3.6.2 Bidder’s Drawing Submission and Approval Procedure

The following procedure for submission and review/approval of the drawings, data reports, information, etc. shall be followed by the bidder:

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for Employer's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.

c. All drawings (including those of sub-vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.

d. Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. The OPTCL/BHEL reserves the right to request any additional information that may be considered necessary in order to fully review the drawings. Drawings for approval shall be submitted as paper prints and shall bear the approved contract references.

f. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

g. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).

h. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

i. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

j. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

3.6.3 As Built Drawings

After completion of work on site all drawings shall be revised where necessary to show the equipment as installed and three copies submitted duly signed by site-in-charge. Following approval, two reproducible transparencies and twenty prints shall then be provided as required by the OPTCL/BHEL and shall be of sufficient detail to enable all parts to be identified. The bidder shall also submit, where possible, digitally stored copies of all as-built drawings on disc or CD-ROM in a format compatible with the Employer's drawing system.

Approval of drawings will not in any way relieve the Bidder of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.6.4 Operation and Maintenance Manual

a. The Bidder shall submit to the Employer preliminary instruction manuals for all the equipment for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. After approval by the Engg. In charge the Bidder shall deliver ten (10) copies of the complete manual.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.

e. The manuals shall include the following
   a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
   b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals) have been supplied to the Employer.

3.6.5 Final Submission of drawings and documents

The Bidder shall furnish the following after approval of all drawings /documents and test reports:
a. List of drawings bearing the Employer's and Bidder's drawing number.

b. Six (6) bound sets along-with two (2) sets of CD-ROMs/ DVD/Portable hard disk of all final drawings/documents.
c. Bidder shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Bidder shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
d. The Bidder shall also furnish four (4) copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of instruction/ operations & maintenance manuals (after approval) for all the equipment.

3.6.6 Test Reports

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

3.7 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity' heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

3.8.1 Space Heaters

Space heaters where provided shall be suitable for continuous operation at 240V supply voltage. On-off switch and fuse shall be provided.

One or more adequately rated permanently or thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimise deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature at approximately 10C, above the outside air temperature to prevent condensation. This shall be demonstrated by tests.

3.8.2 Fungi Static Varnish

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

3.8.3 Ventilation Openings

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

3.9 CLEANING, PAINTING AND TROPICALASATION

3.9.2 General

All paints shall be applied in strict accordance with the paint manufacturer's instructions.

All painting shall be carried out on dry and clean surfaces and under suitable atmospheric and other conditions in accordance with the paint manufacturer's recommendations.

An alternative method of coating equipment such as with epoxy resin-based coating powders will be permitted, subject to the approval of the Engg. In charge (Divisional Engr.), and such powders shall comply with the requirements of IEC 455. The Bidder shall provide full details of the coating process to the Engg. In charge (Divisional Engr.) for approval.

It is the responsibility of the Bidder to ensure that the quality of paints used shall withstand the tropical heat and extremes of weather conditions specified in the schedules. The paint shall not peel off, wrinkle, be removed by wind, storm and handling on site and the surface finish shall neither rust nor fade during the service life of the equipment.

The colors of paints for external and internal surfaces shall be in accordance with the approved color schemes.

3.9.3 Works Painting Process

All steelworks, plant supporting steelworks and metalwork, except galvanised surfaces or where otherwise specified, shall be shot blasted to BS 7079 or the equivalent ISO standard. All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS 6005 "Code of Practice for phosphating iron and sheet steel". All surfaces shall then be painted with one coat of epoxy zinc rich primer, two pack type, to a film thickness of 50 microns. This primer shall be applied preferably by airless spray and within twenty minutes but not exceeding one hour of shot blasting.
All rough surfaces of coatings shall be filled with an approved two pack filler and rubbed down to a smooth surface.
The interior surfaces of all steel tanks and oil filled chambers shall be shot blasted in accordance with BS 7079 or the equivalent ISO, and painted within a period of preferably twenty minutes, but not exceeding one hour with an oil resisting coating of a type and make to the approval of the BHEL/OPTCL.
The interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning and priming as required above, shall be painted with one coat zinc chromate primer, one coat phenolic based undercoating, followed by one coat phenolic based finishing paint to a light or white colour. For equipment for outdoor use this shall be followed by a final coat of anti-condensation paint of a type and make to the approval of the BHEL/OPTCL, to a light or white colour. A minimum overall paint film thickness of 150 microns shall be maintained throughout.
All steelworks and metalwork, except where otherwise specified, after preparation and priming as required above shall be painted with one coat metallic zinc primer and two coats of micaceous iron oxide paint followed by two coats of either phenolic based or enamel hard gloss finished coloured paint to the approval to an overall minimum paint film thickness of 150 microns.
Galvanised surfaces shall not be painted in the works.
All nuts, bolts, washers etc., which may be fitted after fabrication of the plant shall be painted as described above after fabrication.
The painted metal works shall be subjected to paint qualification test as per draft ANSI/IEEE-Std 37.21 - 1985 clause 5.2.5.

3.9.4 Colour Schemes

The Bidder shall propose a colour scheme for the sub-station for the approval of BHEL/OPTCL. The decision of BHEL/OPTCL shall be final. The scheme shall include:

- Finishing colour of indoor equipment
- Finishing colour of outdoor equipment
- Finish colour of all cubicles
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Employer"s electrical equipment in Employer"s switchyard are painted with shade 631 of IS: 5 and Employer will prefer to follow the same for this project also. All indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be subject to the approval of the BHEL/OPTCL.

Sl. No.	Equipment	Application Environment			
		Indoor		Outdoor	
		Colour	Code IS:5	Colour	Code IS:5
400kV/220kV/132kV Class Equipment					
1	Transformers	—	—	Light grey	631
2	Marshalling boxes, CTs, PT's, CVT's, surge counter casings, junction boxes etc.	Light Admiralty grey.	697	Light Admiralty grey.	697
3	Control and relay panels, PLCC cabinets etc.	Smoke grey	692	—	—
4	Porcelain parts i.e. insulators	Dark brown	412	Dark brown	412
5	All structures/ metallic parts exposed to atmosphere	Hot dip galvanised			
33kV Class equipment					
6	Switchgear cubicles	Smoke grey	692	Light grey	631
7	Control and relay panels	Smoke grey	692	—	—
	LT switchgear				
8	LT switchgear exterior	Smoke grey	692	Light grey	631
9	ACDB/ MCC	Smoke grey	692	Light grey	631
10	DCDB	Smoke grey	692	—	—
11	LT bus duct in side enclosure	Matt Paint		—	—
12	LT bus duct outside enclosure	Smoke grey	692	—	—
13	Motors	Smoke grey	692	Light grey	631
14	Diesel generator engine	Smoke grey	692	—	—
15	Diesel generator	Smoke grey	692	—	—
16	LT transformers	Smoke grey	692	Light grey	631
17	Battery charger	Smoke grey	692	—	—
18	Mimic diagram 400kV 220kV 132kV 33kV 11kV 415V	 Dark violet Golden yellow Sky blue Signal red Canary yellow Middle brown	 796 356 101 537 309 411	 — — — — — —	 — — — — — —
	Miscellaneous				
19	Control modules and console inserts	Smoke grey	692	Light grey	631
20	Lighting package equipment outside	Light grey	631	Light grey	631
21	Lighting package equipment inside	Glossy white		Glossy white	
22	Water pipes	sea green	217	sea green	217
23	Air pipes	Sky blue	101	Sky blue	101
24	Transformer oil pipes	Light brown	410	Light brown	410
25	Fire Installations	Fire red	536	Fire red	536
26	Insulating oil/ gas treatment plant	Gulf red	473	Gulf red	473

Table 10.3.4. Recommended color schemes

3.10 DEGREES OF PROTECTION

Degrees of protection shall be provided in accordance with IEC 144 and IEC 529 and be as follows:

- For outdoor applications, IP 55.
- For indoor applications where purpose built accommodation is provided, e.g. switch and control and relay rooms in auxiliary plant buildings, IP 41.
- Where dust can adversely affect equipment within the enclosure, this equipment should be separately housed with a degree of protection of IP 51.

- For indoor applications where the equipment is housed in the same building as that enclosing water and steam operated equipment, the degrees of protection stated in the previous paragraph shall be up-rated to IP 44 and IP 54 respectively.

Where more severe environments exist, e.g. steam and oil vapour or other deleterious chemical environments, special measures will be necessary and the degree of protection required will be specified separately.
The Bidder shall submit a schedule for providing the degree protection to various control boxes, junction boxes etc. for the BHEL/OPTCL's approval.

3.11 RATING PLATES, NAME PLATES AND LABELS

a) All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions. Each phase of alternating current and each pole of direct current equipment and connections shall be coloured in an approved manner to distinguish phase or polarity.

b) The material of all labels and the dimensions, legend, and method of printing shall be to approval. The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light.

c) Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. „Danger" plates shall have red lettering on a white background.

d) All labels and plates for outdoor use shall be of non-corroding material. Where the use of enamelled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws.

e) Labels shall be engraved in Hindi, English and Oriya. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards.

f) Any other relevant information which may be required for groups of smaller items for which this is not possible e.g. switch bays etc. a common name plate in Oriya with the title and special instructions on it shall be provided.

g) No scratching, corrections or changes will be allowed on name plates.

h) All equipment mounted on front and rear sides as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.

i) On the top of each panel on front as well as rear sides large name plates with bold size lettering shall be provided for circuit/ feeder/ cubicle box designation.

j) All front mounted equipment shall be also provided, at the rear, with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment wiring.

k) Name plates of cubicles and panels may be made of non rusting metal or 3 ply lamicoid. These name plates may be black with white engraved lettering.

l) The name plate inscription and size of name plates and letters shall be submitted to the BHEL/OPTCL/ Engineer for approval.

m) The nameplates of the apparatus shall include, at least, the information listed below, together with any other relevant information specified in the applicable standards:
- Concise descriptive title of the equipment
- Rating and circuit diagrams
- Manufacturer's name, trade-mark, model type, serial number
- Instruction book number
- Year of manufacture
- Total weight (for capacitor racks indicate weight, for capacitors indicate quantity of liquid)
- Special instructions, if any, about storage, transportation, handling etc.

n) Each measuring instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW etc. All relays and other devices shall be clearly marked with manufacturers name, manufacturer's type, serial number and electrical rating data.

o) Danger plates and plates for phase colours shall be provided as per requirement. The Bidder shall devise a system to designate equipment and sub-systems. The nameplates/labels displaying these designations shall be installed at appropriate locations. Whenever motion or flow of fluids is involved, plates showing direction of motion or flow shall also be provided.

3.12 BOLTS AND NUTS

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate national standards for metric threads, or the technical equivalent.
Except for small wiring, current carrying terminal bolts or studs, for mechanical reasons, shall not be less than 6 mm in diameter.

All nuts and pins shall be adequately locked. Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising or electro galvanising to service condition 4. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

Where bolts are used on external horizontal surfaces where water can collect, methods of preventing the ingress of moisture to the threads shall be provided.

Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary.

Protective washers of suitable material shall be provided front and back on the securing screws.

3.13 GALVANISING:

3.13.1 General

All machining, drilling, welding, engraving, scribing or other manufacturing activities which would damage the final surface treatment shall be completed before the specified surface treatment is carried out.

3.13.2 Galvanising

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot dip galvanised. High tensile steel nuts, bolts and spring washers shall be electro galvanised to service condition 4. All steel conductors including those used for earthing and grounding (above ground level) shall also be galvanised according to IS 2629.

All galvanising shall be applied by the hot dip process and shall comply with IS 2629, IS 2633, IS 4759, IS 1367 or IS 6745.

All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to galvanising. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

The threads of all galvanised bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the BHEL/OPTCL. All nuts shall be galvanised with the exception of the threads which shall be oiled. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.

Partial immersion of the work will not be permitted and the galvanising tank must therefore be sufficiently large to permit galvanising to be carried out by one immersion.

Galvanising of wires shall be applied by the hot dip process and shall meet the requirements of IS 2141.

The minimum weight of the zinc coating and minimum thickness of coating for outdoor equipment shall be as follows:

a)	For sections & plates above 5mm of thickness	910 gm/sq.m	127 microns
b)	For sections & plates below 5mm of thickness	610 gm/sq.m	87 microns
c)	For surfaces embedded in concrete	800 gm/sq.m.	

The galvanised surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects such as discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanising no drilling or welding shall be performed on the galvanised parts of the equipment excepting that nuts may be threaded after galvanising. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

The galvanised steel shall be subjected to six one minute dips in copper sulphate solution as per IS 2633.

Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanising tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

3.14 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

The terminal connectors shall conform strictly to the requirements if the latest versions of following standards as amended up-to-date, except otherwise,

i)	IS: 5561	Power Connectors
ii)	IS: 617	Aluminium & Aluminium Alloy
iii)	IS: 2629	Recommended Practice for HDG of iron & steel
iv)	IS: 2633	Method of testing uniformity of coating of zinc coated articles

The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 4mm thick bimetallic liner.

The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last at least till erection time.

3.15 CABLE GLANDS AND LUGS/FERRULES

Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs and ferrule shall conform to DIN standards.

3.16 WIRING, CABLING AND CABLE INSTALLATION

3.16.1 Cubicle wiring

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Bidder shall furnish a detailed drawing of such inter panel wiring. The Bidder shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.
All wiring shall be carried out with 1.1 kV grade, PVC insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '29' and Temperature index not less than 250C. The wires shall have annealed copper conductors of adequate size comprise not less than three strands
The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows:

- All circuits excepting CT circuits and energy metering circuit of VT 2.5 sq.mm
- All CT circuits and metering circuit of VT 2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.
Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.
Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.
All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the interconnecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.
Wire termination shall be made with solderless 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. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9).
Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.
The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked "**Trip**".
It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.
The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and "**DANGE**R" notices shall be affixed to the outsides of junction boxes or marshalling kiosk.
Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

3.16.2 LV power cabling

LVAC cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs.
Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.
Terminals shall be marked with the phase colour in a clear and permanent manner.
A removable gland plate shall be provided by the Bidder. The Bidder shall be responsible for drilling the cable gland plate. ere
Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

3.17 PRODUCTION PROCESS REQUIREMENTS

3.17.1 CASTINGS

GENERAL

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings which do not undergo machining, shall be free from foundry irregularities. The castings shall be subject to NDT, chemical, mechanical and metallographic tests. Details of the same shall be furnished to BHEL/OPTCLfor review/approval. Magnetic particle inspection (MPI) test, wherever applicable, shall be carried out in longitudinal and transverse direction to detect radial and axial cracks.

IRON CASTINGS

Iron casting material shall be in accordance with ASTM A 126 Class B. A copy of the ladle analysis shall be sent to the BHEL/OPTCL. Each casting shall have a test bar from which tension test specimens may be taken. Test specimen shall be in accordance with ASTM A 370 and tested in accordance with ASTM E8. The Bidder shall submit his procedures for testing and acceptance for iron castings for approval by the BHEL/OPTCL.

STEEL CASTINGS

Steel castings shall be manufactured in accordance with ASTM A 27 and shall be subjected to appropriate tests and inspection as detailed herein.
Copies of mandatory documentation, such as ladle analyses and mechanical test results, shall be sent to the BHEL/OPTCL. (Non-ferrous casting material and castings shall be manufactured in accordance with the appropriate ASTM standards for the material concerned).

3.17.2 FORGINGS

When requested by the BHEL/OPTCL, forgings will be subjected to inspection in the regions of fillets and changes of section by suitable method. Magnetic particle, dye-penetration, radiographic or ultrasonic, or any combination of these methods may be used to suit material type and forging design.
The testing is to be carried out after the rough machining operation and is to be conducted according to the appropriate ASTM standards.
MPI test on forging shall be carried out to detect both radial and axial cracks. Ferrous forgings shall be demagnetised after such tests.

Any indentations which prove to penetrate deeper than 2.5% of the finished thickness of the forging shall be reported to the BHEL/OPTCLgiving location, length, width and depth. Any indentations which will not machine out during final machining shall be gouged out and repaired using an approved repair procedure. Repair of rotating elements by welding will only be accepted subject to detailed examination of the proposal by the BHEL/OPTCLprior to the repair being carried out.
The forging shall be tested for mechanical and metallographic tests as per ASTM. The details shall be mutually discussed/agreed upon.

3.17.3 FABRICATED COMPONENTS

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM or material specification approved by the BHEL/OPTCL.
Structural steel, rolled shapes, bars, etc. shall comply with the latest ASTM for A36.
Plate steel shall be of a designation and quality suitable for the function it is intended to perform. Insofar as it is compatible with its function, it shall comply with ASTM A283 structural quality.
All, or a representative number of such components, shall be subjected to one or more of the following tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiographic. These tests shall be in accordance with the recommended practices of the ASTM. The terms of reference for acceptance shall be the applicable ASTM Specifications.

3.17.4 WELDING AND WELDERS QUALIFICATIONS

General

All welding shall be carried out by qualified welders only.

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers.
Other standards to determine the quality of welding process and qualifications of welders may be considered, provided that sufficient information is first submitted for the approval of the BHEL/OPTCL.
Prior to the start of fabrication, the Bidder shall submit to the BHEL/OPTCLfor approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.
The Bidder shall be responsible for the quality of the work performed by his welding organisation. All welding operators, to be assigned work, including repair of casting, shall pass the required tests for qualification of welding procedures and operators. The BHEL/OPTCL reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests at the samples.
The Bidder shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator will be required to pass appropriate prequalification tests as specified by the Inspector and at the expense of the Bidder.

Welding

All welding shall be performed in accordance with the appropriate standards. The design and construction of welded joints subject to hydraulic pressure shall conform to the applicable requirement of ASME "Boiler and Pressure Vessel Code" shall be qualified in accordance with Section IX of this Code. The design and construction of welded joints not subjected to hydraulic pressure shall, as a minimum, conform to the requirements of AWS "Specification for Welded Highway and Railway Bridge" D2.0. Except for minor parts and items specifically exempted from stress relieving, all shop welded joints shall be stress relieved in accordance with the requirements of the ASME "Boiler and Pressure Vessel Code" Section VIII.
In addition to satisfying the procedural and quality requirements set forth in the applicable code and/or these Specifications, all welding shall meet the following requirements for workmanship and visual quality:

- Butt welds shall be slightly convex, of uniform height and shall have full penetration.
- Fillet welds shall be of the specified size, with full throat and legs of equal length.

- Repairing, chipping and grinding of welds shall be done in a manner which will not gouge, groove or reduce the thickness of the base metal.
- The edges of the member to be joined shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations or other injurious defects.

Welded joints subject to critical working stress shall be tested by approved methods of non-destructive testing, such as radiographic and ultrasonic examination, magnetic particle and liquid penetration inspection. All expenses in connection with these tests shall be borne by the Bidder. The extent of testing shall be as stipulated by the ASME „Boiler and Pressure Vessel Code", Section VIII, but without prejudice to the rights of the Inspector or the BHEL/OPTCL to ask for additional tests,
The arc-welding process to be used and the welding qualifications of the welders employed on the work shall be used in accordance with AWS requirements and Section VIII and IX of the ASME (American Society of Mechanical Engineers) Code, latest edition, as they may apply. All welding rods shall conform to the requirements of the latest issue of Section It, part C of the ASME Code.
Gas shielded welding (TIG or MIG) used as appropriate for aluminium, stainless steel or other material shall be carried out in accordance with the best commercial practice and the following standard specifications:

- Specifications for copper and copper-alloy welding rods (AWS A5.7, ASTM B259)
- Specification for corrosion-resisting chromium and chromium-nickel steel welding rods and bare electrodes (AWS A5.9, ASTM A371)
- Specifications for aluminium and aluminium alloy rods and bare electrodes (AWS A5.10, ASTM B285).
- Specifications for nickel and nickel-base alloy bare welding filler metal (AWS A5.14, ASTM B304).

Gas welding will not normally be used in the equipment. When a particular equipment manufacture requires the use of gas welding, the proposed process and the welder"s qualification shall be in accordance with AWS B3.0.
Welding of galvanised components will not be allowed in the equipment.
Strict measures of quality control shall be exercised throughout the Equipment/ Works. The BHEL/OPTCL may call for an adequate NDT test of the work of any operator, who in his opinion is not maintaining the standard of workmanship. Should this NDT test prove defective, all work done by that operator, since his last test shall be tested at the Bidder"s expense. If three or more of these tests prove defective, the operator shall be removed from the project.
A procedure for the repair of defects shall be submitted to the BHEL/OPTCL for his approval prior to any repairs being made.

Welding of pipes
Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.
Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
Welding shall be done by manual oxy-acetylene or manual shielded metal are process. Automatic or semi-automatic welding processes may be done only with the specific approval of BHEL/OPTCL.
As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
Downward technique is not allowed while welding pipes in horizontal position, unless permitted by the BHEL/OPTCL.
Combination of welding processes or usage of electrodes of different classes or makes in a particular joint shall be allowed only after the welding procedure has been duly qualified and approved by the BHEL/OPTCL.
No backing ring shall be used for circumferential butt welds.
Welding carried out in ambient temperature of 5C or below shall be heat treated.

A spacer wire of proper diameter may be used for weld root opening but must be removed after tack welding and before applying root run.
Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.
Electrodes size for tack welding shall be selected depending upon the root opening.
Tack welds should be equally spaced.
Root run shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.
The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.
On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.
Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

3.18 QUALITY ASSURANCE

3.18.1 GENERAL

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Bidder's works or at his Sub-Bidder's premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant Indian or otherwise Authorized Standards the Bidder shall adopt suitable Quality Assurance Programs and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification,

approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.18.2 SUB-VENDOR

The Bidder shall ensure that the Quality Assurance requirements of this Specification are followed by any sub-vendor appointed by him under the Contract.
The Bidder shall assess the sub-vendor's Quality Assurance arrangements prior to his appointment to ensure its compliance with the appropriate ISO 9000 standard and the Specification.
Auditing of the sub-vendor's Quality Assurance arrangements shall be carried out by the Bidder and recorded in such a manner that demonstrates to the OPTCL/BHEL the extent of the audits and their effectiveness.

3.18.3 QUALITY ASSURANCE DOCUMENTS

The Bidder shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (√) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.
Typical contents of Quality Assurance Document are as below:-

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
v) Heat Treatment Certificate/Record (Time- temperature Chart)
vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Bidder for the agreed Customer Hold Points.
viii) Certificate of Conformance (COC) whoever applicable.
ix) MDCC

Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.18.4 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.
For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

3.18.5 INSPECTION, TESTING & INSPECTION CERTIFICATE

i. The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

ii. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

iii. The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

iv. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

v. When the factory tests have been completed at the Bidder's or sub-bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

vi. In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

vii. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

viii. To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

ix. All inspection, measuring and test equipment used by bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.19 TYPE, ROUTINE & ACCEPTANCE TESTS:

The Bidder shall carry out the tests stated in accordance with the conditions of this Specification, without extra charge for such additional tests as in the opinion of the BHEL/OPTCL are necessary to determine that the Contract Works comply with this Specification. The tests shall be carried out generally in accordance

with the relevant IEC"s or IS or equivalent standards. The specific details of testing and inspection are given in the appropriate section of this Specification.

The Bidder shall submit Type Test Reports for all equipment being supplied by him for the BHEL/OPTCL"s approval. The BHEL/OPTCL may also give instruction to carry out Type Tests, routine tests or acceptance tests. Type Test Charges shall be paid as per the rates indicated in the Price Schedules.

All materials used shall be subjected to such routine tests as are customary in the manufacture of the types of plant included in the Contract Works. These materials shall withstand satisfactorily all such tests.

All tests shall be carried out to the satisfaction of the BHEL/OPTCL, in his presence, at such reasonable times as he may require, unless agreed otherwise. Not less than three weeks' notice of all tests shall be given to the BHEL/OPTCL in order that he may be represented if he so desires. As many tests as possible shall be arranged together. Six copies of the Bidder"s test reports and test sheets shall be supplied to the BHEL/OPTCL for approval.
Measuring apparatus shall be approved by the OPTCL/BHEL (Divisional Engr) and if required shall be calibrated at the expense of the Bidder at an approved laboratory.

The Bidder shall be responsible for the proper testing of the work completed or plant or materials supplied by a sub-bidder to the same extent as if the work, plant or materials were completed or supplied by the Bidder himself.

All apparatus, instruments and connections required for the above tests shall be provided by the Bidder, but the BHEL/OPTCL may permit the use for the tests on site, any instruments and apparatus which may be provided permanently on site as part of the contract works conditional upon the Bidder accepting liability for any damage which may be sustained by such equipment during the test.

The bidder shall supply suitable test pieces of all materials as required by the BHEL/OPTCL. If required by the BHEL/OPTCL, test specimens shall be prepared for check testing and forwarded at the expense of the Bidder to an independent testing authority selected by the BHEL/OPTCL.

Any costs incurred by the Employer in connection with inspection and re-testing as a result of a failure of the subject under test, or damage during transport, or erection on site before take-over by the Employer, shall be to the account of the Bidder.

No inspection or lack of inspection or passing by the BHEL/OPTCLof work, plant or materials, whether carried out or supplied by the Bidder or sub-bidder, shall relieve the Bidder from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

3.20.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS

a) All equipment to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
b) However if bidder is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of techno-commercial bid opening **(11-February-2022),** or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such

tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.20 PACKAGING & TRANSPORTATION

The Bidder shall be responsible for the packing, loading and transport of the plant and equipment from the place of manufacture, whether this is at his own works or those of any Bidder, to Site, and for off-loading at site.

All apparatus and equipment shall be carefully packed for transport by air, sea, rail and road as necessary and in such a manner that it is protected against tropical climate conditions and transport in rough terrain and cross country road conditions. The method of packing shall provide complete protection to all apparatus and equipment during transport and storage at site in heavy rain. The method of packing shall provide adequate protection to main items of plant and those parts contained within and attached without, for transportation.

Precautions shall be taken to protect parts containing electrical insulation against the ingress of moisture.

All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected.

The machined face of all flanges shall be protected by means of a blank disc bolted to each face.

Where appropriate all parts shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Each crate or container shall be marked clearly on the outside of the case to show "TOP" and "BOTTOM" positions with appropriate signs, and where the mass is bearing and the correct position for slings. Each crate or container shall also be marked with the notation of the part or parts contained therein, contract number and port of destination. It shall be the Bidder"s responsibility to dispose of all such packing.

Any damage due to defective or insufficient packing shall be made good by the Bidder at his own expense and within reasonable time when called upon by the BHEL/OPTCL to do so. Four (4) copies of complete packing lists showing the number, size, marks, mass and contents of each package shall be delivered to the BHEL/OPTCL immediately the material is despatched.

The Bidder shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Bidder shall also be responsible for verifying the access facilities specified.

The Bidder shall be responsible for all costs of repair or replacement of the equipment, including those incurred by the Employer, arising from damage during transport, off-loading or erection on site, until take-over by the Employer.

The Bidder shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Bidder shall immediately report to the BHEL/OPTCL any claims made against the Bidder arising out of alleged damage to a highway or bridge.

3.21 ENCLOSURES:

1. ANNEXURE – A: SPECIFICATION FOR ELECTRICAL COMPONENTS

1. MOTORS

1.1 General

All motors shall comply with IEC 34 / IS 335 and dimensions with IEC 72, however they shall be capable of operating continuously under actual service conditions without exceeding the specified temperature rises, determined by resistance, at any frequency between 48 and 51.5Hertz together with any voltage between ±10per cent of the nominal value.

All motors shall be totally enclosed, and if situated in the open they shall be weatherproof and suitable for outdoor working. They shall be provided with a suitable means of drainage to prevent accumulation of water due to condensation and with suitable means of breathing.

Motors operating in an ambient temperature not exceeding 40°C shall have insulation to at least ClassB and preferably ClassF standards. The temperature rise shall be restricted to that associated with ClassB insulation. Where the motor may be appreciably affected by conducted heat the class of insulation shall be to approval.

All motors shall be suitable for direct starting at full voltage.

Motors shall have sealed ball or roller bearings.

The three line connections of AC motors shall be brought out to a terminal box. The terminal arrangement shall be suitable for the reception of aluminium cable. Terminal markings shall be made in a clear and permanent manner and shall comply with IEC 34. A permanently attached diagram or instruction sheet shall be provided giving the connections for the required direction of rotation. All terminal boxes shall be of the totally enclosed type designed to exclude the entry of dust and moisture and sealed from the internal air circuit of the motor. All joints shall be flanged with gaskets of neoprene or other approved material. Natural rubber insulation shall not be used.

Motors rated above 1 kW shall be three phase motors. Where single phase motors are employed the motors shall be grouped so as to form an approximately balanced three phase load.

1.2 Motor control gear

Control gear shall comply with the requirements of IEC292, the control gear being rated according to the duty imposed by the particular application.

Motor contactors shall comply with IEC158 class of intermittent duty 0-3 with type 52 enclosure protection. Apparatus shall be capable of switching the stalled current, and shall have a continuous current rating of at least 50per cent greater than the full load current of the motors they control.

The operating currents of overload trips fitted to motor contactors shall be substantially independent of ambient temperature conditions, including the effect of direct sunlight on the enclosure in which the contactors are installed.

Where small motors are connected in groups, the group protection shall be arranged so that it will operate satisfactorily in the event of a fault occurring on a single motor. The control and protection equipment shall be accommodated in the control cabinet or marshalling kiosk.

Each motor or group of motors shall be provided with control gear for starting and stopping by hand and automatically. Overload and single-phasing protection shall be provided.

2.0 CABLE BOXES

Cable boxes shall be suitable for cables entering from above or below as may be required. They shall be weatherproof, rodent and insect-proof and be complete with all gaskets, compression glands, wiping glands and all associated fittings as may be required to make-off the cables.

Gland plates shall be insulated from the cable boxes and, in the case of single core cables, shall be of non-magnetic or insulating material. If metallic gland plates are used, single core cable glands shall be insulated from the gland plate. Gland plate insulation shall be capable of withstanding a dry high voltage test of 2000volts ac for one minute.

Where cable boxes are provided for three core cables, the sockets on the outer phases shall be inclined towards the centre to minimise opening of the cable cores. Cable sockets shall be supplied under this Contract.

Cable boxes for voltages up to and including 11kV shall be suitable for PVC or XLPE insulated steel wire-armoured PVC served cables. The boxes shall be air insulated and designed to accommodate all the fittings required by the cable manufacturer. Front covers and gland plates shall be removable and a 12mm diameter breathing hole covered with a wire gauze shall be provided.

Cable boxes shall be capable of withstanding on site the cable high voltage test level in accordance with IEC 502.

The drilling of gland plates, supply and fitting of compression glands and connecting up of power cables not included in the Contract scope of work shall be carried out under a separate contract.

Connection of the power cables included in the Contract scope of works shall be carried out under this Contract.

3.0 TERMINAL BOARDS AND TERMINAL BLOCKS

Terminal boards shall be of good quality non-flammable insulating material with a comparative tracking index (CTI) of not less than 500 to IEC112.

Terminal boards shall be spaced not less than 150 mm apart. For relay panels, they shall be mounted at the sides of the cubicle, and set obliquely towards the rear doors to give easy access to termination and to enable ferrule numbers to be read without difficulty.

Studs of stud type terminal boards shall be locked in the base to prevent turning and all connections shall be made on the front of the terminal board using lock nuts or lock washers. Where crimped type termination are provided at least two sets of crimping tools for each size of crimp must be supplied for each installation.

Terminals shall be of the insertion clamp type incorporating captive pressure screws which do not bear directly on the wire but on a serrated clamping plate. The pressure screws shall have an inherent locking feature.

Where connections are to be made between multi-core cables and telephone type multi-pair cables, the terminal blocks shall be of the insulation displacement type and shall have a withdrawable insulated link in order to facilitate isolation (or busy out in the case of the apparatus associated with the telephone system) of the individual circuits. These terminals shall also be provided with facilities for the insertion of test probes on both sides of the link.

All terminations shall be numbered for identification and grouped according to function. Engraved white on black labels shall be provided on the terminal blocks.

Terminals for connections which exceed 110 Volts shall be separated from those of other circuits and shall be fitted with insulating screens and “DANGER” notices.

The use of terminal blocks as junction points for wires which are not required in the associated cubicle shall be avoided wherever practicable.

All termination racks shall have a minimum of 20 per cent spare terminals blocks. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

All internal wiring to be connected to external equipments shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be 650 V grade and have

10A continuous rating. Terminal blocks shall be moulded in one piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal blocks shall include a white fibre marking strip with clear plastic, slip-on/clip-on terminal covers. Markings on the terminal strips shall correspond to terminal numbers on the wiring diagrams.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Current transformer secondary leads shall be provided with short circuiting and earthing facilities.

All terminal blocks shall be suitable for terminating on each side, two by 2.5 mm^2 standard copper conductors.

Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors on each side :

- All CT and VT circuits : Minimum of two 2.5 mm^2 copper stranded.
- AC/DC power supply circuits : One 16 mm^2 aluminium.
- All other circuits : Minimum of one of 2.5 mm^2 copper stranded

There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate or panel side wall, as per the terminal block mounting arrangement adopted. Also the clearance between the edges of two rows of terminal blocks shall be minimum of 150 mm.

Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal blocks opposite the wiring duct shall be reserved for external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold it firmly and to enable free and flexible termination without causing strain on terminals.

All necessary cable terminating accessories such as gland plates, supporting clamps and brackets, wiring troughs and gutters etc. including glands and lugs for cable shall be in bidders scope of supply.

4.0 FUSES AND LINKS

Carriers and bases for fuses and links shall be in accordance with IEC 269 and colour coded to permit identification of the circuit rating.

The fuses and links mounted in cubicles for tripping circuits and protective gear test links shall be mounted on the front of the panel. Other links and fuses shall be accommodated within the cubicle or above the cubicle doors. Fuses and links shall be grouped and spaced according to their function in order to facilitate identification.

All incoming circuits in which the voltage exceeds 125V shall be fed through insulated fuses and/or links, the supplies being connected to the bottom terminal. The contacts of the fixed portion of the fuse or link shall be shrouded so that accidental contact with live metal cannot be made when the moving portion is withdrawn.

Main supply fuse links shall be of the high rupturing capacity cartridge type.

Where fuse carriers are mounted vertically the incoming (supply) side shall be the bottom terminal.

Where either fuses or circuit breakers are used it should be ensured that proper discrimination between main and sub-circuits is maintained.

5.0 COMMUNICATIONS CABLES

All cables and wiring shall have copper conductors and PVC insulation and shall comply with IEC 227. Telephone type cables shall comply with IEC 96 and IEC 189.

Cabling and wiring installations shall be arranged to minimise the risk of fire and damage which may be caused in the event of fire.

For telephone type cables conductor wires with a cross sectional area of less than 0.2 mm^2 shall not be used. Where twin or quad make up is required in any cable the cores shall be uniformly twisted and the lays arranged such that crosstalk is reduced to a minimum.

No conductor smaller than 32/0.2mm (1mm^2), or having less than three strands shall be used for interconnecting cabling except in the case of telephone cables. All cables shall have insulation which will withstand the highest temperature to be experienced in service.

Each conductor of a multi-core cable shall be readily identified by a numbered marker tape or, in the case of telephone type cables, colour coded insulation.

The Bidder shall submit full details of all loading on cables and in the case of interposing current transformer connections, the loop resistance of each circuit.

Apparatus cubicles, cabinets, racks and panels shall be provided with gland plates and all necessary equipment for the termination of cables. The Contract Works shall include for the checking, termination and ferruling of the cable cores and their lacing into cable forms and connection to the equipment terminal boards or tag blocks using claw washers. Crimping ferrules shall be used for each conductor.

6.0 MARSHALLING KIOSKS AND CONTROL CABINETS

The bidder shall provide within every bay of the switch yard a bay marshalling kiosk to which all incoming and outgoing connections to and from the associated bay equipment will be run. The terminal blocks within the kiosks shall be grouped together by function and shall be properly labelled and segregated. Transformer and circuit breaker control/marshalling kiosks will be provided under a separate contract, but it shall be the contractor"s responsibility to cable up to the control/marshalling kiosks as provided by the transformer and circuit breaker suppliers. The Contractor shall provide a separate stand alone kiosk for busbar protection CT marshalling and the kiosk shall house the CT shorting and switching relays required for the correct function of the busbar protection scheme.

All outdoor cabinets and kiosks shall be protected in accordance with Class IP55 of IEC 947-1 and shall be insect and rodent proof. The minimum sheet steel thickness for all cubicles, kiosks and panels shall be not less than 2 mm cold rolled or 2.5 mm hot rolled sheet steel. The top of the outdoor boxes/kiosks shall be provided with Aluminium alloy sheets having 2 mm thick with proper sloping for easy discharge of water.

Anti-condensation heaters, 240V AC single phase, shall be provided and shall be controlled by a watertight switch mounted externally. Ventilation louvres shall be provided, suitably lined internally with a mesh screen, and divisions between compartments shall be perforated.

Control cabinets shall be illuminated with a switch operated and fused 240V CFL tube. Control cabinets shall be provided with a switch operated single phase 240V 15A power socket.

All cables shall enter cabinets and kiosks at the base.

Each compartment of all kiosks and cabinets shall be provided with access doors at the front and rear. Doors and access covers shall not be secured by nuts and bolts but shall be fastened with integral handles with provision for locking with a padlock.

Doors for kiosks shall be of the lift off and hinged type and shall be provided with glazed windows of adequate size to facilitate reading of indicators from outside the kiosk. Facilities shall be provided to permit removal of the temperature indicators without the need to pass the capillary tubing and bulb through the various compartments.

Doors and covers under 15kg mass may be of the slide on pattern, but above this mass hinged doors shall be used. Door shall be provided with padlocking facilities.

When three phase connections rated at 380V and above are taken through cabinets or kiosks, the terminal blocks shall be adequately screened, insulated and suitably marked with the phase colour; "DANGER" notices shall be affixed to the terminal blocks and a DANGER notice stating the voltage shall be fixed on the inside and outside of the kiosk or cabinet. Exterior DANGER notices shall be stove enamelled and shall be written in English and Oriya and shall be of an approved class/grade.

A durable copy of the circuit wiring diagram shall be affixed to the back of the kiosk door and labels shall be provided inside each kiosk or box to describe the functions of the various items of equipment.

When the marshalling kiosks are positioned in side the switchyard , flood water shall not ingress in to the marshalling kisok. The contractor/bidder may achieve the same either positioning the marshalling kiosk appropriately or providing adequate water proof arrangement.

CT, CVT & IVT outdoor kiosks shall be of Aluminium alloy sheets having 3mm thickness. It shall have proper slop canopy for easy drainage of water.

7.0 AUXILIARY SWITCHES

With each disconnector, contactor and earthing device, there shall be supplied all necessary auxiliary switches and mechanisms for indication, protection, control, interlocking, supervisory and other services as specified. Not less than four spare auxiliary switches of each type shall be provided.

All auxiliary switches shall be wired up to a suitable terminal board on the fixed portion of the switchgear whether they are in use or not in the first instance, and shall be arranged in the same sequence on all similar items of equipment. Switches shall be provided to interrupt the supply of current to the tripping mechanism of the circuit breakers and latched contactors. All such switches and mechanisms shall be mounted in accessible positions clear of the operating mechanism, and shall be adequately protected.

The contacts of all auxiliary switches shall be strong and be capable of adjustment in relation to the movement of the circuit breaker or other item of equipment. Auxiliary switches and auxiliary circuits shall be capable of carrying a continuous current of 10 Amps.

8.0 MINIATURE OR MOULDED CASE CIRCUIT BREAKERS

Miniature or moulded case circuit breakers (MCB"s or MCCB"s) shall be designed and tested in accordance with IEC 157 and supplementary requirements of this specification. They shall be suitable for use over the full range of expected voltage variation as specified in the Schedules.

MCB"s and MCCB"s shall be suitably rated for both the continuous and short circuit loading of the circuits they are protecting under all service and atmospheric conditions stated in the specification. The bidder shall ensure that correct discrimination is maintained between main and sub-circuits.

For three phase circuits, the miniature circuit breakers shall be of the three pole type; for single phase circuits they shall be of the single pole type and for dc circuits they shall be of the double pole type.

Where miniature circuit breakers are used in circuits containing inductive loads, e.g. operating coils, it is essential that they are suitable for satisfactory operation in the circuit in which they are used, i.e. account is taken of the circuit time constant.

All miniature circuit breakers shall be provided with an auxiliary contact for remote indication of circuit breaker operation.

Means shall be provided to prevent the miniature circuit breakers being inadvertently switched to the „OFF" position.

Miniature circuit breakers shall be mounted in such a manner so as to give easily visible indication of breaker position and shall be grouped and spaced according to their function in order to facilitate identification and easy replacement.

9.0 SPACE HEATERS

Heaters shall be suitably designed to prevent any contact between the heater wire and the air. They shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air.

Alternatively, they may consist of a resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

10.0 LVAC CABLES (NOT APPLICABLE)

10.1 General

LVAC power cables shall have aluminium conductors with XLPE insulation, galvanised steel wire armour and PVC oversheath and shall comply with the requirements of IEC 227, 228 and 502 as applicable. Cables shall be sized to carry the highest anticipated load under the worst case ambient conditions. Where a three, three and a half or four core power cable is provided, the cores shall be coloured to distinguish the relevant phases.

All sheaths shall be free from defects and impervious to water.

10.2 1.1kV grade power and control cables

10.2.1 Codes and Standards

The design, manufacture, testing and performance of cables covered under this specification shall comply with latest edition of the standards including amendments as indicated in the relevant schedules attached to this specification.

10.2.2 Technical requirements

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and chances of flooding by water.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE insulated LV power cables shall withstand without damage a three phase fault current of at least 45 kA for a minimum of 0.12 seconds, with an initial peak of 105 kA in one of the phases. The armour for XLPE insulated power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

Strip wire armouring following method (a) of the relevant IS shall not be accepted for any of the cables. For control cables round wire armouring only shall be used.

Cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

All the cables shall pass fire resistance test as per IS 1554 (Part-I)

The normal current rating of all PVC insulated cables shall be as per IS 3961.

Repaired cables shall not be accepted.

10.3 LV XLPE power cables

XLPE insulated cables shall conform to IS 7098 (Part-I) and its amendments read along with this Specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multi-core cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multi-core cables even if they are unarmoured. For armoured or unarmoured cables, the inner sheath shall be of extruded PVC to type ST-2 of IS 5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

10.4 LV XLPE power cables

PVC (70C) insulated 1100V grade power cables shall conform to IS 1554 (Part-I) and its amendments, read along with this Specification and shall be suitable for a steady conductor temperature of 70°C . The conductor shall be stranded aluminium. Insulation shall be extruded PVC to type-A of IS 5831. A distinct inner sheath shall be provided in all multi-core cables. For multi-core armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS 5831 for all cables.

10.5 LV PVC control cables

The 1100V grade control cables shall conform to IS 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The oversheath shall be extruded PVC to type ST-1 of IS 5831 and shall be grey in colour except where specifically advised by the Project Manager to be black.

Cores shall be identified as per IS 1554 (Part-1) for cables up to five cores and for cables with more than five cores the identification of cores shall additionally be done by printing legible alphabets on all cores. The alphabets shall be white and shall be printed at approximately 100 mm intervals along the cable length. Cables without such core identifications will not be accepted.

10.6 Cable drums

Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drums shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The Project Manager shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of ± 2%.

A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

10.7 Tests

All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

The temperature index tests shall be carried out as per ASTM-D-2863.

All cables shall meet the fire-resistance test as per IS 1554 (Part-I)

10.8 Cable sizes

Following standard sizes of cables shall be considered by Bidder for various power distribution and protection,control and metering purposes in the system:

- XLPE power cables: 1c 630 mm^2, 1c 300 mm^2, 3 $^1/_2$c 300 mm^2. (armoured)
- LV XLPE power cables: (armoured)1c 150 mm^2, 3½ c70 mm^2, 3½c 35 mm^2, 4c 16 mm^2, 4c 6 mm^2, 2c 6 mm^2.
- PVC control cables: 2c 2.5 mm^2, 3c 2.5 mm^2, 5c 2.5 mm^2, 7c 2.5 mm^2, 10c 2.5 mm^2, 14c 2.5 mm^2, 19c 2.5 mm^2, 27c 2.5 mm^2

11.0 BUSHINGS

All bushings shall comply with the requirements of IEC 137 and the associated barrel porcelains shall comply with IEC 233 together with the requirements of this Specification. Provision shall be made for the fitting of arcing horns.

Transformer bushings rated at 66 kV and above shall be either of the oil impregnated paper or resin impregnated type. When filled with transformer oil there shall be no connection with the oil in the transformer and an oil gauge shall be provided. The visible oil levels in the gauge shall correspond to the range of average oil temperatures, from the minimum ambient stated in the Schedules to plus 70C. The oil level at 15C shall be marked. Connections from the main windings to bushings shall be flexible and shall be such that undue mechanical stresses are not imposed on them during assembly on site.

Terminal clamps shall be supplied with each bushing for flexible or rigid busbars as may be required. The material of the clamps shall be as stated in the Schedules.

12.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

Bushings shall be manufactured and tested in accordance with IS 2099 and IEC 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IS 2099/IEC 273. The insulators shall also conform to IEC 815 as applicable.

The bidder may also offer composite silicon insulators conforming to IEC 36.

Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and other similar defects.

Support insulators, bushings and hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators or bushings when operating at the normal rated voltage.

Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up, porcelain parts by grinding and metal parts by machining. Insulator and bushing design shall be such as to ensure a uniform compressive pressure on the joints.

12.1 Tests

In accordance with the requirements stipulated above bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS 2099 and IS 2544.

All routine tests shall be conducted on hollow column insulators as per IEC 233. In addition the following tests shall also be conducted

1. Ultrasonic test as a routine test.
2. Pressure test as a routine test.
3. Bending load test in four directions at 50% specified bending load, as a routine test.
4. Bending load test in four directions at 100% specified bending load, as a sample test on each lot.
5. Burst pressure test as a sample test on each lot.
6. Hollow porcelain insulators should be in one integral piece in green and fired stage. No jointed porcelain will be acceptable.

12.2 Technical parameters of bushings, hollow column insulators and support insulators:

Parameter	420kV	245kV	145kV	36kV
Rated voltage kV	420	245	145	36
Impulse withstand (wet and dry) kVp	±1425	±1050	±650	±170
Switching surge withstand (wet and dry) kVp	±1050			
Power frequency withstand (wet and dry) kVrms	630	460	275	70
Total creepage distance mm	10500	6125	3625	900

Pollution level shall be Class III Heavy as per IEC 71, and as specified in Schedules for all classes of equipment.

Insulators shall also meet the requirements of IEC 815 for 420kV, 245kV and 145kV systems as applicable having alternate long and short sheds.

13.0 CIRCUIT BREAKERS

13.1 General

Circuit breakers shall be of three pole air break design, horizontal draw out type in accordance with IEC 947-2. In particular, evidence shall be provided of the performance when switching currents in the critical current range. They shall be capable of the ratings specified in the Schedules, when mounted in the switchboard.

Circuit breakers shall be fitted with trip-free, spring-operated mechanisms of the independent manually operated type and be provided with making and over current release facilities. A push-button shall be provided to trip the breaker electrically.

The breaker shall be provided with **`OPEN'. `CLOSE', `SERVICE', `TEST'** and **`SPRING CHARGED'** position indicators and shall be provided with the necessary number of auxiliary contacts for interlocking, indication and tripping purposes plus two spare.

Each incoming circuit shall be provided with thermal overload relays and short circuit protection relays; they shall also be provided with an undervoltage relay to trip breaker in the event of a supply failure.

There shall be `**SERVICE**', `**TEST**' and fully withdrawn positions for the breakers. It shall be possible to close the door in „**TEST'** position.

Movement of a circuit breaker between „**SERVICE'** and „**TEST'** positions shall not be possible unless it is in „**OPEN'** position. Attempted withdrawal of a closed circuit breaker shall not trip the circuit breaker.

Closing of a circuit breaker shall not be possible unless it is in „**SERVICE'**, „**TEST'** or fully withdrawn positions.

A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

Circuit breakers shall be provided with electrical anti-pumping and trip free feature.

Means shall be provided to slowly close the circuit breaker in withdrawn position if required for inspection and setting of contacts. In service position slow closing shall not be possible.

Circuit breakers shall be provided with the following mechanism as specified in the Bill of Material.

13.2 Power operated mechanism

Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class `E' or better.

The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically be mechanically decoupled.

All circuit breakers shall be provided with closing and tripping coils. The closing coils shall operate correctly at all values of voltage between 85% to 110% at rated control voltage. Tripping coils shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

Provision for mechanical closing of the breaker only in `**TEST**' and withdrawn positions shall be made.

14.0 RELAYS

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. Auxiliary relays and timers may be furnished in non-drawout cases.

All AC relays shall be suitable for operation at 50 Hz with 110 volts VT secondary and 1A or 5A CT secondary.

All protective relays and timers shall have at least two potential free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate numbers of terminals shall be available on the relay cases for applicable relaying schemes.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flags) for analysing the cause of operation.

All relays shall withstand a test voltage of 2kV (rms) for one minute.

Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type terminal overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

All fuse protected, contactor controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bi-metallic strips), or as a separate device. The single phasing protection shall operate with 80% of the set current flowing in two of the phases.

15.0 CONTACTORS

Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS 2959.

Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

Direct line starter contactors shall be of utilisation category AC2. These contactors shall be as per IS 1822.

Each contactor shall be provided with two normally open (NO) and two normally close (NC) auxiliary contacts.

Operating coils of contactors shall be of 240V AC unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. Contactors shall drop out at 70% of the rated voltage.

16.0 INSTRUMENT TRANSFORMERS

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

Current transformers may be multi or single core type. All voltage transformers shall be single phase type. Busbar VT‟s shall be housed in a separate compartment.

All VT‟s shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

17.0 INDICATING INSTRUMENTS

All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

Ammeters provided on motor feeders shall have a compressed scale at the upper current region to cover the starting current.

Watt-hour meters shall be of three phase, three element type. Maximum demand indicators need not be provided.

18.0 CONTROL AND SELECTOR SWITCHES

Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show the function and positions. Switches shall be suitable for flush mounting with only switch front plate and operating handle projecting from the panel front. Switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. Handles of different shapes along with suitable inscriptions on switches shall be provided as an aid to switch identification. The selection of operating handles for the different types of switches shall be as follows :

Switch Type	Application	Specification
Switchgear control switches	For closing and opening of breakers and isolators.	Pistol grip, black, three position type.
Synchronising switches	For synchronising check bypass facilities	Oval, black, keyed (common removable handle, or with locking facility and common key).
Selector switches	Auto, manual, local, remote and test facilities	Oval or knob, black
Instrument switches	Phase or meter selection	Round, knurled, black
Protection transfer switch	Transfer of protection.	Pistol grip, lockable and black.

TABLE 18.1 Switch operating handles

The control switches of breakers and isolators shall be of spring return to neutral type. The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively. They shall have at least two (2) contacts closing in close positions, and two (2) contacts closing in Trip positions unless specified otherwise.

Circuit breaker selector switches for breaker controlled motors shall have three stay put positions marked „**AUTO'**, „**MANUAL'** and „**TEST'** respectively. They shall have two contacts each of three positions and shall have black, pistol grip handles.

Instrument selection switches shall be of maintained contact stayput type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondaries when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltages for non effectively earthed systems, and for reading all line to line voltages for effectively earthed systems. Ammeter and voltmeter selector switches shall have four stayput positions with an adequate number of contacts for three phase four wire systems. These shall have black oval handles

Synchronising switches shall be of maintained contact stayput type having a common removable handle for a group of switches. The handle shall be removable only in the „**OFF'** position and it shall be co-ordinated to fit in to all the synchronising switches. These switches shall be arranged to connect the synchronising equipment when turned to the „**ON**" position. One contact of each switch shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the „**ON**" position.

Lockable type switches which can be locked in particular positions shall be provided when specified. The key locks shall be fitted on the operating handles.

The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlocking and function of the scheme. The contact rating of the switches shall be as follows :

	Contact rating in Amps		
Description	**220V DC**	**50V DC**	**240V AC**
Make and carry continuously	10A	10A	10A
Make and carry Make and carry for 0.5 sec.	30A	30A	30A
Break			
Resistive load	3A	20A	7A
Inductive Load with L/R=40ms	0.2A	—	—

TABLE 18.2 Contact ratings of switches

19.0 AIR BREAK SWITCHES

Air breaker switches shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS 4064.

The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.

Switch operating handles shall be provided with padlocking facilities to lock them in `OFF' position.

Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in `OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.

Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

20.0 PUSH BUTTONS

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push-buttons shall be provided with integral escutcheon plates marked with the appropriate function.

The colour of the button shall be as follows :

GREEN : For motor **START**, breaker **CLOSE,** valve /damper **OPEN**

RED : For motor **TRIP**, breaker **OPEN,** valve /damper **CLOSE**

BLACK : For overload reset, all annunciator and miscellaneous functions.

All push-buttons on panels shall be located in such a way that red push buttons shall always be to the left of green push buttons.

21.0 INDICATING LAMPS

Indicating lamps shall be of the panel mounting filament type and low watt consumption. Lamps shall be provided with series resistors, preferably built-in the lamps assembly. The lamps shall have

escutcheon plates marked with its function, wherever necessary. Lamps shall have translucent lamp covers of colours appropriate to the application as indicated in Table 21.1

Colour	Indication
RED	For motor **ON**, breaker/isolator **CLOSED**, valve/damper **OPEN**
GREEN	For motor **OFF**, breaker /isolator **OPEN**, valve/damper **CLOSE**
WHITE	For motor **Auto-Trip**
BLUE	For all healthy conditions (e.g. control supply) and also for **'SPRING CHARGED"**
AMBER	For all alarm conditions (e.g. overload) Also for `**SERVICE**' and `**TEST**' positions indicators.

TABLE 21.1 Indicating lamp colours

Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and amber lamps should normally be located above the red and green lamps.

When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button.

The wattage and resistance of the lamps shall be as follows:

- 220/250V 5 - 10W 4000 - 8000 ohms
- 110V 5 - 10W 1000 - 2000 ohms

Neon indicating lamps or LED"s shall be provided when specified. The wattage of the neon lamp shall be 0.25 to 0.5W.

Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

22.0 FUSES

All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be of Class 2 type, 20kA (RMS) breaking current at 415V AC, and for DC circuits Class 1 type 4kA breaking current.

Fuses shall have visible operation indicators.

Fuses shall be mounted on fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, they shall be directly mounted on plug in type bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

Fuse ratings shall be chosen by the bidder depending upon the circuit requirements and these shall be subject to approval of Project Manager.

23.0 NAME PLATES AND LABELS

All switchgears and ACDC distribution boards etc. shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also. Language shall coform to the requirements stipulated elsewhere in the technical specification..

All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to Project Manager"s approval.

Suitable plastic sticker labels shall be provided for easy identification of all equipment, located inside the panel or module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.

24.0 ELECTRIC MOTORS (LV)

24.1 Codes and Standards

All motors shall conform to the latest revisions of the relevant IEC, Indian Standards, British Standards given in the schedules, except where modified or supplemented by this Specification.

The design, manufacture, installation and performance of motors shall conform to the provisions of latest Indian Electricity Act and Indian Electricity Rules. Nothing in these specifications shall be construed to relieve the bidder of his responsibility in this regard.

In case of contradiction between this specification and IS or BS or IEC, the stipulations on this specification shall prevail.

National Electrical Code for Hazardous locations and relevant NEMA standard shall also be applicable for motors located in hazardous location.

24.2 Service conditions and temperature rise

Unless otherwise specified, machines shall be designed for a maximum ambient air temperature of 50C. Accordingly the temperature rise of the stator winding by resistance method over the ambient air temperature shall not exceed 70C.

For applications where the motor temperatures may be appreciably affected by conducted or radiated heat, the amount of heat must be specified by the bidder and the appropriate temperature rises agreed.

24.3 AC Motors

24.3.1 General

All AC motors shall be of squirrel cage type, unless otherwise specified and shall be suitable for direct on line starting.

Each motor shall be assigned a maximum continuous rating (MCR) corresponding to 70C temperature. Maximum continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment at designed capacity.

Rated voltage for AC motors shall be as given below for various MCR"s of the motor, unless specified otherwise:

- From 0.2 kW to 220 kW 415 V, three phase, 50 Hz
- Below 0.2 kW 240 V, single phase, 50 Hz

Voltage and frequency variations shall be as per clause 3.3 of IS 325.

The lowest voltage at the motor terminals throughout the starting period, with which the driven equipment shall satisfactorily start up even under the most arduous conditions specified, shall be 85% for motors rated up to 110 kW, and 80% for motors rated above.

The accelerating torque at any speed with the lowest starting voltage shall be at least ten (10) percent of rated full load torque of the motor.

The motors shall be suitable for two starts in succession under the specified conditions of load, torque and inertia, with the motor initially at its normal running temperature.

The ratio of locked rotor kVA at rated voltage to rated kW (MCR corresponding to 70C temperature rises) shall not exceed the following (without any further tolerance):

Motor MCR kW	Start kVA/Rated kW
Up to 110kW	1.0
Above 110kW	10.0

When tests to determine the breakaway starting current of cage induction motors are taken at reduced voltage, due allowance shall be made for the effect of saturation. The estimated value of breakaway starting current at rated voltage shall be given on all test certificates.

All motors shall be so designed that the maximum inrush currents and locked rotor and pull out torque, developed by them at 110% of the rated voltage, do not endanger the motor or the driven equipment.

The pull out torque at rated voltage shall not be less than 200 percent of the full load torque.

Motors for reciprocating compressors etc. shall be specially designed/rated to withstand the torque pulsation produced by the driven equipment.

24.3.2 Transient recovery

The motors shall be capable of resuming normal operation after a system disturbance causing temporary loss of supply voltage for periods of up to 0.2 second (fault clearance time), followed by sudden restoration to 70 percent rated voltage. From this voltage the motors shall be capable of acceleration and ultimate recovery under the most arduous load conditions.

24.4 DC Motors

DC motors shall comply with IS 4722 and shall be shunt wound type rated for 220V. Motor MCR kW rating at 50C ambient shall be at least ten percent higher than the power requirement of the driven equipment under the most onerous operating conditions foreseen during the plant's life.

DC motors which are to operate from batteries shall be capable of operating continuously under actual service conditions at any voltage between 190V and 240V.

DC motors supplied from rectifier equipment connected to AC power supplies shall meet the voltage and frequency variations specified for AC motors.

Rectifier equipment shall be capable of meeting the condition of transient recovery given above for AC motors and shall be provided with the necessary current limiting devices.

The pull-out torque of DC motors at the rated voltage shall not be less than 200 percent of the full load torque.

24.5 Enclosure and method of cooling

The following types of enclosure may be supplied:

- Totally enclosed, fan ventilated.
- Totally enclosed, closed air circuit, integral heat exchanger.
- Totally enclosed, closed air circuit, machine mounted heat exchanger.

In all cases protective enclosure and method of cooling of motors shall be IP 54 and IC 0141 in accordance with IS 4691 and IS 6362 respectively.

Cooling fans shall be directly driven from the motor shaft.

Motors situated outdoors or exposed to the weather shall be weather protected (IPW-55).

All totally enclosed type of motors shall have a dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6 mm diameter.

24.6 Constructional features

All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved. Glass fibre or plastic components, where employed, shall be of adequate design and robustness taking into account the conditions of service required and the effects of operating temperatures, ageing and thermal stability of the material. The material shall be resistant to flame propagation.

Rotors shall be so designed as to keep the combined critical speeds with the driven equipment away from the running speed by at least 20%.

Motors and their major components such as stators, rotors, terminal boxes, bearings and heat exchangers shall be designed to be readily interchangeable as integral units.

All motor rotors shall be dynamically balanced.

The enclosures shall be designed to provide an effective sealing between the primary and secondary air circuits.

The radial air gap between stator and rotor shall have an adequate margin to minimise the possibility of rubbing between the stator and rotor due to eccentric positioning, play and wear, shaft deflection due to rotor weight and unbalanced magnetic pull etc. The minimum radial air gap for all motors shall be in accordance with Clause 5.1.5 of IS 6381.

All requirements of clause 5.1.4 of IS 6381 shall also be complied with.

All the induction motors shall be capable of running at 75% of rated voltage for a period of 5 minutes.

Induction motors shall be designed to be capable of withstanding the voltage and torque stresses developed due to the difference between motor residual voltage and incoming supply voltage equal to 150% of the rated motor voltage during fast changeover of buses. The necessary features incorporated in the design to comply with this requirement shall be clearly indicated in this proposal.

24.7 Variable speed motors

Variable speed motors shall be such that the speed can be continuously adjusted over the required range. The speed control gear shall be provided with an interlock to ensure that the motor can only be started when its control sequence is at the correct setting. When the motor is switched off, the speed control sequence shall automatically return to this position.

24.8 Brush gear, commutators and slip-rings

Brush gear, commutators and slip-rings shall be designed to operate without injurious sparking and to run for at least three months without the need for adjustment or replacement of brushes.

Brushes shall be of electro graphite or metal graphite type. Adequate precautions shall be taken to protect the windings, commutators, slip-rings and brush gear against deposits of entrained carbon dust.

Removable covers shall be fitted to provide access to the brush gear, commutators and slip-rings. For totally enclosed type motors, windows shall be provided to permit observation of the brush gear whilst the motor is running.

Brush holders shall be of non-ferrous materials and located securely to accurately position the brushes on the commutator. Means for adjusting brush pressure and brush assembly shall be provided.

24.9 Internal electric heaters

Internal electric heaters shall be provided on motors rated above 30 kW, to maintain the windings in a dry condition during periods of standstill. The heater shall be suitable for use on a 240V, 50 Hz, AC supply.

24.10 Lifting facilities

All heavy parts of the motors shall be provided with adequate arrangements for lifting or handling during erection or overhaul.

All material used for equipment construction including castings and forging etc. shall be of tested quality as per relevant codes and standards. No welding shall be carried out on cast iron components for repair or any other purpose.

24.11 Winding and insulation

Winding insulation shall be of class B or better and of proven high quality and reliability.

All winding insulation shall be non-hygroscopic, oil resistant and of materials resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site during the installation period and also during normal operation.

All winding overhangs and leads shall be adequately supported, braced and blocked to provide sufficient rigidity during all normal conditions of service.

Cage windings and all joints shall be designed to give an adequate safety factor on fatigue due to thermal and mechanical stresses, taking into account the specified starting and running conditions. The short-circuiting and rings shall be of joint less construction. All electrical joints and connections shall be of brazed or welded construction.

Motors shall be designed to give a life endurance of at least 18000 starts.

24.12 Bearings

Bearings shall be of rolling type. Vertical motors shall normally have rolling type guide and thrust bearings.

Bearings shall be designed to prevent ingress of dust and water and shall be sealed against leakage of lubricant along the shaft.

When the motor shaft is not located axially by its own bearings, it shall be permanently marked to indicate its normal running position and the extent of float in either direction.

Bearings shall comply with the relevant Indian or International Standards. The bearing housing shall be correctly packed with lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

For direct drives, bearings shall have an expected life of at least 40,000 running hours. For motors with significant external radial or axial loads, e.g. belt drives, bearing shall have a life of at least 15000 running hours. The bearing assembly shall be provided with a grease relief device to eject any surplus grease in to a separate container.

Lubrication shall be possible without removal of the guarding. All grease nipples, oil cups and dip sticks shall be readily accessible.

24.13 Heat exchangers

An adequate margin shall be included in the design of heat exchangers to allow for fouling of cooling tubes or ducts under service conditions. Provision shall be made for the easy cleaning of the cooling tubes or ducts, preferably on load.

The cooling tubes or ducts shall be adequately braced and supported to prevent vibration and premature fatigue or fracture.

24.14 Noise level

Noise levels shall comply with BS 4999, Part-51.

24.15 Vibration level

The double amplitude of vibrations as measured at motor bearings shall be within the limits specified in IS 4729, and the limits specified for the driven equipment.

24.16 Earthing terminals

Two independent earthing points shall be provided in accordance with IS 3043(1966), on opposite sides of the motor for bolted connection of Employer's earthing conductor.

24.17 Terminal boxes and associated fittings

Terminal boxes for motors rated above 110 kW shall be capable of withstanding a system fault level of 31 MVA for 0.12 seconds.

Unless otherwise approved, the terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

415 volt terminals shall be suitable for receiving 1.1 kV grade PVC or XLPE, unarmoured or armoured power cables.

Only three line terminals need be brought out from each three phase primary winding. All inter phase connections whether star or delta shall be made inside the machine.

Marking of all terminals shall be in accordance with IS 4728.

Leads from terminals to the windings shall be adequately sized and braced to withstand heating and forces produced by maximum fault current.

Cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.

All joints other than those on cable glands shall be gasketted with neoprene, neoprene bonded cork or other approved material.

For single core cables, gland plates shall be effectively non-magnetic.

The following shall be supplied along with each motor :

1. Crimping type tinned copper lugs for power cables, with all necessary hardware.
2. Compression type tinned brass cable glands for power cables (to be supplied loose).
3. Removable type undrilled gland plate.
4. Terminal boxes shall of weather proof construction with a degree of protection of IP-55. At least one motor of each batch shall be type tested to comply with the following : the terminal boxes shall be subject to an internal air pressure of 0.207 bar g for 12 hours. After this period the pressure shall not be less than 0.104 bar g (after correcting for any change in temperature).

24.18 Rating plate

In addition to the requirements as called for in General Technical Clauses and relevant IS, the rating plate shall indicate the following:

- Maximum continuous rating in kW for 70C temperature rise.
- Bearing identification numbers (in case of ball or roller bearings) and recommended lubricant.

24.19 Paint and finish

All external parts shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, and sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint. Motor colour codes shall comply with the requirements indicated elsewhere in this Specification.

All fasteners used in the construction of the equipment shall be either of corrosion resistant material or electro galvanised to service condition 4. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

24.20 Tests

Induction motors shall be subjected to the following routine and type tests.

24.20.1 Routine Tests

Visual Checks of the following:

- Marking on rating plates
- Appearance and painting
- Location and details of terminal boxes and accessories.
- In order to observe compliance to degree of protection, following test will be performed. It shall not be possible to insert a feeler gauge of 1 mm thick in the enclosure or flange faces.

Dimensional checks

Measurement of Insulation Resistance (IR) of windings, and space heaters.

Measurement of winding resistance, and space heater resistance at ambient temperature.

High voltage test on main windings, and space heaters.

IR measurement after HV test in main windings, and space heaters.

No load running test (reading of current, voltage input and speed measurement).

Measurement of bearing temperature during steady state conditions.

Vibration measurement at rated speed and rated voltage, also measurement of vibration during coasting down.

Reduced voltage running test at no load

Locked rotor test.

Phase sequence polarity check and check for terminal markings.

Over speed test

Measurement of air gap

Functional check on auxiliaries

24.20.2 Type Tests

All tests as listed under routine tests

Measurement of noise at no load

Locked rotor test - measurement of VA power input

Momentary overload test

Temperature rise test at rated conditions as well as at maximum input conditions (during heat run test, measurement of bearing temperature, winding temperature, core temperature, coolant flow and coolant temperature). In case the temperature rise test is carried at other load than rated load, specified approval for the test method and procedure shall be obtained from the Project Manager.

Degree of protection test for the enclosure followed by IR, HV and no load run test.

Terminal box - fault level withstand test and pressure test.

Pull out torque measurement

Measurement of no-load starting time.

24.20.3 DC motors

DC motors shall be subjected to all routine and type tests as per IS 4722. In addition, following tests shall be carried out:

- Noise level measurement as type test.
- Vibration measurement as routine test
- Degree of protection test as per IS 4691 as type test.

24.21 Junction boxes and cables

Design and selection of all the components shall be made with a good margin of safety factor.

The equipment shall be installed indoor.

The reference ambient temperature outside the equipment shall be taken as 50C and relative humidity as 100%.

25.0 JUNCTION BOXES

25.1 Construction

Bidder shall supply and install junction boxes complete with terminals as required.

Junction boxes shall be suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, cable-glands, screws and all other accessories required for the erection shall be included in the Bidders scope.

Junction boxes shall be of square or rectangular type of 2.0 mm CRCA sheet steel and shall have bolted cover with good quality gasket lining.

Junction box and covers shall be hot dip galvanised.

All the terminals blocks of ESSEN make or equivalent shall be rated for 1100V and shall be of stud type. Each terminal shall be suitable for connecting two 2.5 mm^2 copper conductor.

All terminals shall be complete with insulated barriers, terminals studs, washers, nuts, locknuts, identification strips etc.

Junction boxes located inside shall have IP-54 protection as per IS 2147. Junction boxes located outside shall have IP-55 protection as per IS 2147.

Junction boxes shall be provided with one earthing terminal suitable for galvanised steel conductor.

The general arrangement, cross sectional details and other technical details are to be submitted in the form of drawing for Project Manager‟s approval.

25.2 Interconnecting cables

All cables between junction box and field devices shall be stranded copper conductor, PVC insulated, extruded PVC inner sheathed, single galvanised steel wire armoured and overall PVC sheathed 1.1 kV grade and shall conform to IS 1554. The minimum size of cable used shall be 2.5 mm^2 copper conductor. All cables shall be supplied by the Contractor.

26.0 CONDUIT AND CONDUIT ACCESSORIES

The bidder shall supply and install all rigid steel conduit, flexible conduits, Hume pipes etc. complete with accessories such as tees, bends, adaptors and couplings as required for cabling work between various field devices to junction boxes.

SECTION-4

GUARANTEED AND TECHNICAL PARTICULARS FOR 420kV CIRCUIT BREAKER

As per Annexure A of Section 2

SECTION-5
Checklist for Circuit Breaker

Checklist

1	**Technical Qualifying Requirement**		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/No
1.2	The bidder's scope includes supply and services such as Supervision of installation, Testing and commissioning.	Confirmed	Yes/No
2	**Un-priced BOQ**		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof) Record the same in schedule of technical deviations.	Confirmed	Yes/No
3	**Technical**		
3.1	Minimum Number of auxiliary contacts on each Circuit Breaker - Besides requirement of technical specification, the manufacturer shall wire up 16 NO + 16 NC contacts of each phase/ pole exclusively for purchaser's use and shall be wired up to common marshalling box of 420kV CB.	Confirmed	Yes/No
3.2	Catalogues, indicative OGA of the offered equipment is attached.	Enclosed with bid	Yes/No
4	**Technical Deviations**		
4.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
5	**GTP**		
5.1	All equipment being supplied shall conform to Guaranteed Technical Particulars as per technical specification and applicable IS / IEC	Confirmed	Yes/No

6	**TYPE TESTS REQUIREMENTS**		
6.1	All the equipment offered shall be fully type tested as per the relevant standards (IEC-62271 -100, IEC-60694/IS-12729 with latest amendments) & tests as indicated below. The bids offering equipment not type tested will be rejected. In case, the equipment of the type & design offered has already been type tested, the bidder shall furnish four sets of the type test reports along with the offer. The test must have been conducted not earlier than Ten years from the date of opening of the bids i.e. 11th February 2022. For any change in the design/type already type tested the design/type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost or reject the bid without any intimation.	Confirmed	Yes/No

Date:

Bidder's Stamp & Signature

Contact Details: