PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV CIRCUIT BREAKERS**
SUBJECT	**BID SPECIFIC ATC**

1. **BHEL Contact (Technical):**
For any **technical clarification**, please contact Mr. Debashis Mandal, Sr. Manager (TBEM). Contact No. 0120-674-8539; e-mail: DEVASHIS@BHEL.IN

2. **BHEL Contact (Commercial):**
For any **commercial clarification**, please contact Mr. Sandeep, Dy. Manager (TBMM). Contact No. 0120-674-8540; e-mail: kumar.sandeep@bhel.in

3. **Terms of Payment:**

[A] Payment for 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 breakers 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 from the date 16.02.2025, 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”.

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.

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV CIRCUIT BREAKERS**
SUBJECT	**BID SPECIFIC ATC**

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:

Within 23 Weeks (161 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, storage at site and shifting 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-414-316-004, Rev 00 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, Bidder(s) to submit QAP at contract stage for BHEL/end customer approval

12. Destination/ Delivery Location:

Executive Engineer (Maintenance), UJVNL Ltd, Chilla Power Station,
Chilla, Pauri Garhwal, Via Haridwar, Uttarakhand – 249306

13. 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, 24 months from the date of issue of Taking Over Certificate of the Generating Unit (Taking over date is 16.02.2025) or Eighteen (18) months from the date of last delivery 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.

14. Performance Bank Guarantee (PBG):

As per GeM terms and conditions. Performance BG of **10% 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.

15. 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 (**UJVNL**) 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:

1. Financial documents like balance sheets (last three years).
2. Registration certificate.
3. ISO certificate.
4. Proof of supplies (POs) and/or vendor approval letters in PSUs, SEBs etc.
5. Performance certificate.

Any documents required by customer at the time of vendor approval shall be communicated accordingly.

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

16. 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**."

17. 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.

18. 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%).**

19. 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.

20. Unpriced Bid:

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

21. Details of Bidder:

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

22. Evaluation Criteria:

Evaluation shall be done on total cost to BHEL basis.

23. Deviations:

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

24. 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.

25. 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.

26. 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-XI: 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
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-XIV: Vendor Compliance Format

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

27. 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 : .....

TECHNICAL QUALIFYING REQUIREMENT

Bidder should be manufacturer of the offered Circuit Breaker. Bidder needs to meets the following technical requirements for 145KV Circuit Breaker as stipulated here under:

The manufacturer(s) whose 145 KV Circuit Breaker (s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 132 kV or higher voltage class Circuit Breaker which are in satisfactory operation# for atleast two (2) years as on the original scheduled date of technical bid opening of this tender enquiry.

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

PREPARED BY	REVIEWED BY	APPROVED BY
20/07/23		
Debashis Mandal	Vivek Kapil	Vivek Kapil
Sr. Manager	AGM	AGM

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV CIRCUIT BREAKERS**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-II

ACTIVITY SCHEDULE

SN	ACTIVITY	ACTIVITY TIME [in weeks]	REMARKS
1.	PO / Input receipt from BHEL	1	BHEL SCOPE
2.	Submission of Documents necessary for getting manufacturing clearance like Drawings, Data sheet MQP etc.	4	SUPPLIER SCOPE
3.	Manufacturing Clearance	3	BHEL SCOPE
4.	Manufacturing time and raising of Inspection Call	10	SUPPLIER SCOPE
5.	BHEL/Customer Inspection & Dispatch Clearance	3	BHEL SCOPE
6.	Dispatch	2	SUPPLIER SCOPE
Activity Time for supply:		**23 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

Signature of the authorized representative of

Place : ……..
Date : ……..

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

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV ISOLATORS**
SUBJECT	**BID SPECIFIC ATC**

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 (Including GST)
1.	SUPPLY- CIRCUIT BREAKER : 145KV, 40KA FOR 3S, 25MM/KV CREEPAGE, 1250A, 3-PHASE CIRCUIT BREAKER ALONG WITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, MARSHALLING BOX, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT.	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
2.	SUPPLY- CIRCUIT BREAKER : 145KV, 40KA FOR 3S, FOUNDATION BOLTS FOR COMPLETE 3 PHASE CIRCUIT BREAKER ASSEMBLY (STRUCTURE, CONTROL CUBICLE, PLATFORM AND/OR LADDER)	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
3.	SUPPLY- CIRCUIT BREAKER: 145KV, 40KA FOR 3S 25MM/KV CREEPAGE : SF6 GAS FILLING ADOPTER, INCLUDING COUPLING, REGULATOR, CONNECTING HOSE PIPE UP TO GROUND LEVEL	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
4.	SUPPLY- CIRCUIT BREAKER: 145KV - Portable leak detector	No	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
5.	Spare CIRCUIT BREAKER: 145kV -Complete pole with column and interrupter and grading capacitor (If applicable) and operating mechanism but without support structure	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV ISOLATORS**
SUBJECT	**BID SPECIFIC ATC**

6.	Spare CIRCUIT BREAKER: 145kV -10% extra spare SF6 gas	LOT	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
7.	Spare CIRCUIT BREAKER: 145kV - Set of Rubber gaskets, 'O' rings and seals	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
8.	Spare CIRCUIT BREAKER: 145kV, 40KA, 3S - Molecular Filter	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
9.	Spare CIRCUIT BREAKER - Spring charge motor	No	02	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
10.	Spare CIRCUIT BREAKER: 145kV, 40KA, 3S - Trip coils with resistor	No	06	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
11.	Spare CIRCUIT BREAKER: 145kV, 40KA, 3S - Closing coils with resistor	No	06	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
12.	Spare CIRCUIT BREAKER: 145kV, 40KA, 3S - Pressure switch of each type/Density monitor	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
13.	Spare CIRCUIT BREAKER: 145kV - Fixed and moving arcing contacts	SET	02	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV ISOLATORS**
SUBJECT	**BID SPECIFIC ATC**

14.	Spare CIRCUIT BREAKER: 145kV - Spares for local control cabinet including auxiliary relays, power contactors, limit switches, push buttons, timers, MCB, fuses and terminals	SET	01	Quoted	Quoted **Mention GST % Quoted**	Quoted	Quoted **Mention GST % Quoted**	Quoted
15.	SERVICES-CIRCUIT BREAKER: 145KV, 40KA FOR 3S 25MM/KV CREEPAGE 40KA FOR 3S, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF CIRCUIT BREAKER	No	01	Quoted	Quoted **Mention GST % Quoted**	NA	NA	Quoted

Signature of the authorized representative of

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

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

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-V

Item/ Package Name	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
GeM Bid No.	
Project	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

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 : ……

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

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. 24 of Bid Specific ATC.

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

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				

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
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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				

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
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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 receipt of packages/ Boxes	1 Copy	Damages, if any mentioned in the Receipted LR have been accounted for. Withheld amount, if any_____				

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
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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:

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
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ANNEXURE-X

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/).

PROJECT	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XI

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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
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 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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XIII

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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV Circuit Breaker**
SUBJECT	**BID SPECIFIC ATC**

ANNEXURE-XIV

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	**UJVNL CHILLA HYDRO POWER STATION (4X36MW)**
ITEM	**SUPPLY AND SUPERVISION OF ETC OF 145kV 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 : ……

TECHNICAL QUALIFYING REQUIREMENT

Bidder should be manufacturer of the offered Circuit Breaker. Bidder needs to meets the following technical requirements for 145KV Circuit Breaker as stipulated here under:

The manufacturer(s) whose 145 KV Circuit Breaker (s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 132 kV or higher voltage class Circuit Breaker which are in satisfactory operation# for atleast two (2) years as on the original scheduled date of technical bid opening of this tender enquiry.

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

PREPARED BY	REVIEWED BY	APPROVED BY
20/07/23		
Debashis Mandal	Vivek Kapil	Vivek Kapil
Sr. Manager	AGM	AGM

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-414-316-004	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	DM	VK	VK
TITLE	145KV Circuit Breaker			SIGN			
				DATE	20/07/2023	20/07/2023	20/07/2023
				GROUP	TBEM	W.O. No	
CUSTOMER	UTTARAKHAND JAL VIDYUT NIGAM LIMITED (UJVNL)						
PROJECT	RMU of Chilla HEP (4 X 36MW)						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS	
Distribution				To	TBMM	OFFICE COPY
				Copies	03	01

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project sites and supervision of erection, testing & commissioning of 145 KV Circuit Breaker complete in all respect for efficient & trouble free operation mentioned under this specification. **The breaker shall be used for 1 no. of station transformer (5MVA) bay.**

The specification comprises of following sections

Section-1	Scope, project specific technical requirements & bill of quantities.
Section-2	Standard Technical Specification for Circuit Breaker
Section-3	Project details & general technical Specifications for all the equipments under the project.
Section-4	GUARANTEED TECHNICAL PARTICULARS
Section-5	CHECK LIST

In case of any discrepancies between the requirements mentioned under different Sections, order of precedence shall be as follows:
section-1 shall precede section-2, section-2 shall precede section-3

In general, no major deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer, however bidder shall furnish list of conflicts/ ambiguities/ deviations (if any) in *Schedule of Technical Deviations*. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed. In case the deviations mentioned in the *Schedule of Technical Deviations* are not technically acceptable, the offer of the bidder will be liable to rejection.
The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.
The Circuit Breakers are required for the following Project

Customer: UTTARAKHAND JAL VIDYUT NIGAM LIMITED (UJVNL)
Project : RMU of Chilla HEP (4x36MW)
Refer Section - 3 for Project Details and General Specifications.

2.0 SPECIFIC TECHNICAL REQUIREMENTS

2.1 All equipments shall perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

2.2 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, (wherever applicable) short circuit etc for the equipment.

2.3 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

2.4 Minimum Number of auxiliary contacts on each Circuit Breaker - Besides requirement of technical specification, the manufacturer shall wire up 5 NO + 5 NC contacts of each phase/ pole exclusively for purchaser's use and shall be wired up to common marshalling box of CB.

2.5 All contacts & control circuits to be wired out upto common control cabinet plus **24 spare terminals** exclusively for Owner's use.

2.6 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.

2.7 Cabling & termination schedule for the same shall be provided by successful bidder along with AS BUILT drawing during contract stage.

2.8 TB's for (for incoming AC Power Cables) shall be suitable for size (minimum) **4Cx16** Sqmm Al.

2.9 Following 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 cubical.
- **Cable tray** arrangement to be mounted on Breaker structure
- Breaker **Terminal Pad**

2.10 Terminal connectors are not in bidder's scope of supply (BHEL supplied items)

2.11 Bidder to submit detailed "guaranteed and technical particulars" and "detailed drawings" for Circuit Breakers during contract stage for approval. Bidder may need to visit to BHEL / TANGEDCO corporate engineering office for drawing / document approval if standard approval is not available.

3.0 BILL OF QUANTITIES:

S.No.	DESCRIPTION	UNIT	QTY
	Main Quantity		
1	SUPPLY- CIRCUIT BREAKER : 145KV, 40KA FOR 3S, 25MM/KV CREEPAGE, 1250A, 3-PHASE CIRCUIT BREAKER ALONG WITH SUPPORT STRUCTURE, INTERPOLE CABLES, OPERATING MECHANISM, MARSHALLING BOX, CONTROL BOXES AND ALL ACCESSORIES COMPLETE IN ALL RESPECT.	set	1
2	SUPPLY- CIRCUIT BREAKER : 145KV, FOUNDATION BOLTS FOR COMPLETE 3 PHASE CIRCUIT BREAKER ASSEMBLY (STRUCTURE, CONTROL CUBICLE, PLATFORM AND/OR LADDER)	set	1
3	SUPPLY- CIRCUIT BREAKER: 145kV : SF6 GAS FILLING ADOPTER, INCLUDING COUPLING, REGULATOR, CONNECTING HOSE PIPE UP TO GROUND LEVEL	set	1
4	Mandatory maintenance equipment: 145kB CB- Portable type SF6 Gas leak detector. (The sensing probe of SF6 gas leakage detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.)	No.	1
	Spare items		
5	Spare for 145kV CB -Complete pole with column and interrupter and operating mechanism but without support structure	Set	1
6	Spare for 145kV CB -10% extra spare SF6 gas for use during operation and maintenance in non-returnable cylinders	Lot	1
7	Spare for 145kV CB - Set of Rubber gaskets, 'O' rings and seals (complete replacement for one breaker)	set	1
8	Spare for 145kV CB - Molecular filter for SF6 circuit of 1 pole	set	1
9	Spars for 145kV CB - Spring charge motor	No.	2
10	Spare for 145kV CB - Trip coils with resistor	No.	6
11	Spare for 145kV CB - Closing coils with resistor	No.	6
12	`Spare for 145kV CB -Pressure switch (1 of each type) and Density monitor for SF6 Circuit of 1pole	set	1
13	Spare for 145kV CB - Fixed and moving arcing contact of 1 pole	set	2

S.No.	DESCRIPTION	UNIT	QTY
14	Spare for 145kV CB - Spares for local control cabinet including auxiliary relays, power contactors, limit switches, push buttons, timers, MCB, fuses and terminals	Set	1
	SERVICES		
15	SERVICES- CIRCUIT BREAKER : 145KV, 40KA FOR 3S, SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF CIRCUIT BREAKER UP TO GROUND LEVEL	No	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. a. The scope of Supervision of Erection, testing and commissioning of Circuit Breakers shall be duly inclusive of the following:

   i. Testing equipment required for testing.
   ii. Accommodation and conveyance at site.
   iii. Any other incidental charges.
   iv. Visit charges (To & Fro charges)

4.0 TECHNICAL QUALIFYING REQUIREMENTS:

Please refer the following Annexure: 1 **_TQR**

5.0 SUPERVISION OF ERECTION COMMISSIONING AND TESTING:

Supervision of Erection, testing and commissioning of all the supplied Circuit Breakers are in the bidder's scope. Bidder shall quote lump-sum price for supervision of installation, testing and commissioning of all offered breakers. Supplier's testing engineer shall bring SF6 gas leak detector, SF6 gas filling adopter, timing kit and Transducer for operational analyser (as per requirement).

Required unskilled man power / Labor, tools (other than special tools and tackles which shall be in bidder's scope) shall be provided by BHEL.

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

The following instruments/kits shall be brought out at site by Bidder and shall be taken back after successful completion of testing and commissioning.

a) Time Interval meter (Timing kit)

b) SF6 gas leakage Detector

c)SF6 gas filling adopter

d)Transducer for operational analyzer (if required)

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.

6.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out after 30.05.2014. The reports should have been conducted on identical or similar equipment/components to those offered. if any type report is found to be technically unacceptable, such type test(s) shall be conducted by the bidder free of cost without any cost and delivery implication to BHEL/UJVNL.

7.0 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.

8.0 QUALITY PLAN

Bidder shall submit QAP at contract stage for BHEL/end customer approval.

9.0 TECHNICAL DEVIATIONS:

The bidder shall list all the deviation from the specification separately in Annexure-A. 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.

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TECHNICAL QUALIFYING REQUIREMENT

Bidder should be manufacturer of the offered Circuit Breaker. Bidder needs to meets the following technical requirements for 145KV Circuit Breaker as stipulated here under:

The manufacturer(s) whose 145 KV Circuit Breaker (s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 132 kV or higher voltage class Circuit Breaker which are in satisfactory operation# for atleast two (2) years as on the original scheduled date of technical bid opening of this tender enquiry.

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

PREPARED BY	REVIEWED BY	APPROVED BY
20/07/23		
Debashis Mandal	Vivek Kapil	Vivek Kapil
Sr. Manager	AGM	AGM

STANDARD TECHNICAL SPECIFICATION FOR CIRCUIT BREAKER

(1)

(A) GENERAL

The circuit breakers shall be of SF6 gas filled insulated type with 3-Ø gang operated spring-spring charged operation mechanism complete with all associated equipment & components viz. local control cubicle etc. for local as well as remote operation for 1 No. of **station transformer (5MVA) bay**.

SF6 circuit breakers shall conform to IEC-62271 and shall be compatible with the plant automation SCADA system.

The design and construction of the C.B. shall be such that there is a minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surfaces of the circuit breaker. In the interrupter assembly there shall be an absorbing product box to minimize effect of SF6 decomposed products and moisture. Spring operating mechanism shall be complete with motor.

Opening spring and closing springs with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also to be provided. As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. Breaker operation 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. Closing action of circuit breaker shall compress the opening spring ready for tripping.

When closing springs are discharged after closing a breaker, closing spring, shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet. Provisions shall be kept to prevent a closing operation of the breaker when spring is in partially charged condition. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in closed position.

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 and also to provide the required energy for the tripping mechanism in case of tripping energy is derived from the operating mechanism.

The operating mechanism of the SF6 circuit breakers shall be housed in 3mm thick G.I. sheet IP-56 vermin proof enclosure shall be trip free mechanically or electrically and shall be provided with anti-pumping device. Sufficient auxiliary contacts shall be provided for the local and remote indications related to the circuit breakers in order to ensure the optimal performance of various control and protection schemes and the interlocking scheme. Alarm and cut-off contacts for mechanism faults and gas pressure loss shall also be provided. The SF6 circuit breakers shall be capable of being operated locally as well as from remote. The SF6 circuit breakers shall satisfactorily withstand the high stresses imposed during fault clearing, load rejection & re-energizing of feeder lines with trapped charges.

The circuit breaker shall also be capable of:

i) Interrupting line / cable charging current as per IEC without use of insertion opening resistors.

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

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

The operating mechanism panel shall be fixed at a suitable man working height from ground level. View glass shall be provided on hinged door at the front. Hinged door shall be properly earthed with main body through copper flexible braided conductor. In case operating mechanism box shall not be placed at a suitable man working height, platform is to be arranged / supplied for each such breaker by the contractor. Suitable arrangement at site has to be made near each breaker to climb on the platform and work comfortably. Suitable arrangement shall have to be made for easy accessibility to the operating mechanism box. All necessary arrangements are within the scope of bidder. Indication for spring charged condition shall be provided.

Each circuit breaker including its supporting structure shall be designed to withstand repeated earthquake acceleration of 0.38 and wind loads of 150 Kg/m2 on the project area (non simultaneous) without damage to component parts and without impairments operation.

(B) TECHNICAL PARAMETERS:

S.No.	Parameter	Value
1	Type	SF_6 filled outdoor type
	Nominal system voltage	132kV
2	Highest system voltage	145kV
3	Rated frequency (Hz)	50Hz
4	Number of poles	3
5	Type of operation	Gang Operated for circuit breakers for 1 no. **station transformer (5MVA) bay**
6	Operation mechanism power	Through electrical motor charged springs for both opening as well as closing. One closing operation shall be possible during auxiliary power failure.
7	Spring charging time	Less than 20s
8	Rated normal current	1250A
9	Rated lightning impulse withstand voltage	650 kV (Peak)
10	Rated switching impulse withstand voltage	650 kV (Peak)
11	1-minute power frequency withstand voltage	275 kV (rms)
12	Total break time for any current up to the rated breaking current cycle	Not exceeding 30 milliseconds #
13	Closing time cycle	Not exceeding 120 milliseconds
14	Short time current carrying capacity for 3 s	40 kA(rms)
15	Minimum Ø-Ø spacing in the switchyard i.e. minimum inter-pole spacing for breaker	1700 mm
16	Minimum height of the live part to ground level (up to plinth level)	4600mm
17	Rated transient recovery voltage for terminal fault	249 kV (peak)
18	Rated line/ cable charging current breaking capacity	50A/ 160A
19	First pole to clear factor	1.3

20	Rated small inductive making/ breaking current within permissible switching over voltage	Equivalent to magnetizing current of 160 MVA, 220/132/33 kV transformer
21	Rated single capacitive making/ breaking current within permissible switching over voltage	160A
22	Rated short circuit making current or short circuit peak withstand current at higher rated voltage / lower rated voltage	100kA(peak) /100kA(peak)
23	Rated transient recovery voltage (TRV)	215 kV (peak)
24	Rated transient recovery voltage for out of phase breaking in earthed neutral system	296 kV
25	Rated operating duty	O - 0.3s – CO - 3minute - CO phase
26	Automatic rapid reclosing	3 phase auto reclosing
27	Maximum acceptable difference at the instance of closing / operating of contacts	As per Standard
28	Minimum creepage distance Ø-ground and between circuit breaker terminals.	3625mm
29	No of Trip Coils	2 common coils for gang operated and 2 coils per pole for individual operated poles
30	Number of spare auxiliary contacts	5 NO, 5 NC on each pole wired to terminal blocks in control cabinet (for multiple contacts, fail safe no-volt logic to be deployed).
31	Thermal rating of auxiliary contacts	10A at 220V DC
32	Breaking capacity of auxiliary contacts	24V DC with circuit time not less than 20ms.
33	Main contact material	Silver plated copper
34	Control circuit voltage supply	220V DC
35	Operating mechanism voltage supply	220V DC
36	Space heater and LED light supply	220V AC
37	Electromagnetic Compatibility (EMC)	As per IS 12729 /IEC 60694 normal severity class

If not feasible to achieve, manufacturer to recommend standard value.

(2) DUTY REQUIREMENTS

2.1 The circuit breakers shall be restrike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

2.2 The circuit breakers shall meet the duty requirements for any type of fault of fault location also for line switching when used on a 145 KV effectively grounded system and perform make and break operations as per the stipulated duty cycles satisfactorily.

2.3 The breaker shall be capable of interrupting the steady state and transient magnetizing current corresponding to Auto transformers.

2.4 The circuit breaker shall also be capable of:

i) Interrupting line/cable charging current as per IEC without any restrike and without use of opening resistors.

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

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

2.5 The breakers shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges.

(3) TOTAL BREAK TIME

3.1 The total break time as specified under this chapter shall not be exceeded under any of the following duties:

i) Test duties 1,2,3,4,5 (TRV as per IEC: 62271-100)
ii) Short line fault L75, L90 (--- do---)

3.2 The bidder may please note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%). While furnishing the proof of the total break time of complete circuit breaker, the Bidders 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.

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

(4) CONSTRUCTIONAL FEATURES

The features and constructional details of circuit breakers shall be in accordance with requirements stated hereunder.

4.1 Contacts

The gap between the open contacts shall be such that it can withstand at-least the rated phase to ground voltage for 8 hours at zero gauge pressure of SF6 gas due to the leakage. The breaker should be able to withstand all dielectric stresses imposed on it in open condition to lock out pressure continuously (i.e. 2 p.u. across the breaker continuously).

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

4.3 The SF6 Circuit Breaker shall meet the following additional requirements:

a) The circuit breaker shall be single pressure type. The design and construction of the circuit breaker shall be such that there is a 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. The SF6 gas leakage should not exceed 1% per year. In case the leakage under the specified conditions is found to be greater than 1% after one year of commissioning of circuit breaker, the manufacturer will have to supply free of cost, the total gas

requirement for subsequent ten (10) years, based on actual leakage observed during first year operation after commissioning.

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

d) Each pole shall form an enclosure filled with SF6 gas independent of two other poles and the SF6 gas density of each pole is monitored.

e) The dial type SF6 density monitor shall be adequately temperature compensated to model the pressure changes due to variations in ambient temperature within the body of circuit breaker as a whole. The density monitor shall have graduated scale and shall meet the following requirements:

It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by providing suitable interlocked non return valve coupling.

f) Each circuit breaker shall be capable of withstanding a vacuum of minimum 8 millibars without distortion or failure of any parts.

g) Sufficient SF6 gas including that will be required for gas analysis during testing shall be provided to fill all the circuit breakers installed. In addition, spare gas shall be supplied in separate unused cylinders.

h) Suitable SF6 gas filling adopter one number each for each voltage rating (145 KV) shall be supplied along with breaker.

(i) One number portable / Hand held SF6 gas leakage detector shall be supplied for the entire lot of breakers.

j)Portable SF6 filling unit with Vacuum pump.

4.4 Provisions shall be made for attaching an operational analyzer after installation of circuit breakers at site to record contact level, speed and making measurement of operating timings, Pre-insertion timings of closing resisters if used, synchronization of contacts in one pole.

(5) SULPHUR HEXAFLUORIDE GAS (SF6 GAS)

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

5.2 The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the relevant standards and regulations.

5.3 Test: SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water content as per IEC 376, 376A and 376B and test certificates shall be furnished indicating all the tests as per IEC 376 for each lot of SF6 gas. Gas bottles should be tested for leakage during receipt at site.

5.4 SF6 gas Cylinder.

(6) INSULATORS

6.1 The porcelain of the insulators shall conform to the requirements

6.2 The mechanical characteristics of insulators shall match with the requirements specified under this chapter.

6.3 Test: All insulators shall conform to IEC- 61624 (for pressurized hollow column insulators) and IEC-233 (for others). All routine and sample tests shall be conducted on the hollow insulators as per these standards with requirements and procedures modified as under:

i)Pressure test as a routine test.

ii) Bending load test as a routine test.

iii) Bending load test as a sample test on each lot.

iv) Burst pressure test as a sample test on each lot.

v) In addition to the above ultrasonic test shall be carried out as additional routine test

6.2 The Hollow porcelain for pressurized columns/chambers should be in one integral piece in green and fired stage.

(7) OPERATING MECHANISM AND CONTROL

7.1 General requirements:

7.1.1 Circuit breaker shall be operated by spring charged mechanism for all rating of breakers. This is mandatory requirement. The mechanism shall be housed in a weather proof and dust proof control cabinet.

7.1.2 The operating mechanism shall be strong rigid, not subject to rebound and shall be readily accessible for maintenance for a man standing in ground.

7.1.3 The mechanism shall be anti pumping and trip free (as per IEC definition) under every method of closing.

7.1.4 The mechanism shall be such that the failure of any auxiliary spring will not prevent trapping and will not cause trip or closing operation of the power operating devices.

7.1.5 A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position of the breaker 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 cabinet. A plat form for manual operation / Spring charging and for routine check must be provided for breakers of all voltage class.

For Manual spring charging operation through operating handle.
it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that one man standing at ground level is able to manually charge the spring without much effort. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only. The Bidder should enclose G.A. Drawings with the above provision.

7.1.6 Working parts of the mechanism shall to corrosion resisting material, bearings which require grease & shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breakers.

7.1.7 The bidder shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker. The instruction manuals shall contain exploded diagrams with complete storage handling, erection, and commissioning, troubleshooting, servicing and overhauling instructions.

7.2 CONTROL:

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

7.2.2 Each breaker pole shall be provided with two (2) independent tripping circuits, pressures switches and coils each connected to a different set of protective relays.

7.2.3 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 control switch/push buttons shall be provided in the Breaker central control cabinet.

7.2.4 The trip coils be suitable for trip circuit supervision during both open and close position of breaker. The trip circuit supervision relay would be provided on relay panels.

7.2.5 Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coil and associated circuit shall operate correctly under all operating conditions of the circuit breaker up to 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 operate. If additional elements are introduced in the trip coil circuits, their successful operation and reliability for similar applications on outdoor circuit breakers shall be clearly brought out in the additional information schedules.

7.2.6 Density meter contact and pressure switch contact shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all

auxiliary circuits shall be monitored and provision shall be made for remote annunciations and operation lockout in case of DC failures. Density monitors are to be so mounted that the contacts do not change on vibration during operation of circuit Breaker.

7.2.7 The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

(8) SPRING OPERATED MECHANISM

8.1 The Spring operated mechanism shall be complete with motor. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

8.2 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.

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

8.4 Breaker operation 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 30 sec fort full charging of the closing spring.

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

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

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

8.8 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 and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

(9) SUPPORT STRUCTURE

9.1 The structure design shall be such that during operation of circuit breaker vibrations are reduced to minimum.

9.2 The contractor shall provide suitable platform with steps on both sides of the circuit breaker for easy accessibility for monitoring the density/pressure of gas and for local operation.

(10) TERMINAL CONNECTOR PAD

The circuit breaker terminal pads shall be made up of high quality electrolytic copper or aluminum. The terminal pad shall have protective covers which shall be removed before interconnections. The terminal connectors of 145 KV breakers shall be suitable for single ACSR moose conductor.

(11) INTERPOLE CABLING

11.1 All cables to be used by contractor shall be as per IS-1554 (1100 Volts Grade). All cables within & between circuit breaker poles shall be supplied by the CB manufacturer.

11.2 Only multi stranded conductor shall be used. Minimum size of the conductor shall be 2.5 sq.mm (Copper).

11.2 The cables shall be with oxygen index Min. 29 and temp index as 250°C as per relevant standards.

(12) INTERPOLE CABLING

The operating mechanism housing/control cabinet shall conform to the requirement specified below.

Operating mechanism and all accessories shall be enclosed in a weather-proof cabinet of sheet steel construction, the thickness of which shall not be less than 3mm.

Hinged doors giving access to the mechanism and panel wiring at the front and rear shall be provided. The enclosure shall conform to the degree of protection IP-55.

Suitable space heaters shall be mounted in the housing to prevent condensation. Heaters shall be controlled by differential thermostat so that the cubicle temperature is always, maintained approximately 10 deg C above the outside air temperature. ON/OFF switch and fuse shall be provided for the heaters. Heaters shall be suitable for 240 V AC single phase supply. The heater leads shall be covered with porcelain material up to sufficient length to avoid melting of insulation of the leads.

Adequate number of cable glands shall also be provided along with control cabinet. The number of terminals provided shall be adequate enough to wire out all contacts and control circuits with 10% extra terminals.

(13) INTERLOCKS ALARMS AND INDICATIONS

13.1 Potential free contacts shall be provided, duly wired upto to the operating mechanism housing/control cabinet for the following alarms and indications.

ALARMS :

(a) Low pressure of SF6 gas.
(b) Auto reclosing lock out for low pressure of gas
(c) General lock-out for SF6 gas.
(d) Pole discrepancy
(e) Auxiliary AC/DC failure.

INDICATIONS :

(a) Breaker on off (Both Electrical/Mechanical)
(b) Spring charged (Both Electrical/Mechanical)
(c) Mechanical operation counter.

13.2 It is proposed to electrically interlock the circuit breaker with associated air break isolating switches in accordance with switchyard safety inter-

locking scheme. All spare contacts in Auxiliary switch will be brought out. Sufficient spare terminal preferably minimum terminals in a separate terminal block may be provided in the central control cubicle for wiring 5 NO + 5 NC spare contact from each pole. 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.

13.3 The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate Earthing terminals suitable for bolted connection to mild steel flat to be provided.

(14) FITTINGS AND ACCESSORIES

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

i) Cable glands (double compression type). Lugs ferrules etc
ii) Local/ remote change over switch.
iii) Operation counter.
iv) Pressure gauges.
v) Control switches to cut off control power supply
vi) Fuses 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 future use.
viii) Antipumping relay.
ix) Pole discrepancy relay.
x) D.C Supervision relays.
xi) Rating and diagram plate in accordance with IEC incorporating year of manufacture.
xii) one number Adopter for each voltage rating (110 KV) for SF6 Gas filling (Breaker to filling hose)

(15) ADDITIONAL DATA TO BE FURNISHED ALONGWITH THE OFFER

a) Drawing showing contacts in close arc initiation full arcing, arc extinction and open position.

b) The temperature v/s pressure curves for each setting of density monitor along with details of density monitor.

c) Method of checking the healthiness of voltage distribution devices (condensers) provided across the breakers at site.

d) Data on capabilities of circuit breakers in terms of time ad number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.

e) The effect of non-simultaneity between poles and also show how it is covered in the guaranteed total time.

f) Sectional view of non-return coupling is used for SF6 pipes.

g) Details & type of filters used in interrupter assembly and also the operating experience with such filters.

h) Details of SF6 gas.

i) The test methods used in controlling the quality of gas in the circuit breakers particularly purity & moisture content.

ii) Proposed tests to assess the conditions of the SF6 within a circuit breaker after period of service particularly with regard to moisture contents of the gas.

(16) TEST

Each circuit breaker shall comply with the type test and shall be subjected to routine tests prescribed in latest edition of IEC-62271/IEC-694/IS13118.

Reports of all type tests as stipulated in IEC-62271, IEC-694 or IS-13118 and line charging current and cable charging current and transformer charging & shunt capacitor switching current tests etc. carried out on similar design and rated breaker by internationally recognized test laboratories shall be furnished.

Routine tests as per IEC-62271/IEC-694 or IS-13118 shall be carried out on each breaker in the presence of purchaser's representative if so desired by the purchaser. All test reports shall be submitted and be got approved from the purchaser before the dispatch of the equipment.

(17) ERECTION / COMMISSIONING

All equipment with associated items covered in the specification are intended to be erected and commissioned in the presence of bidder commissioning Engineer. While commissioning the circuit breakers it shall be obligatory on the part of the supplier to comply with the following precautions / conditions:

i) A copy of pre-commissioning tests/ reports and commissioning schedule/checking shall be supplied by the bidder's Engineer at the time of commissioning the circuit breaker for reference and record of the purchaser.

ii) Proper pressure of SF6 gas in the arc-chambers of all the three phases shall be ensured before commissioning the circuit breaker.

iii) Bidder's commissioning Engineer shall be required to be present at the time of commissioning and also at the time of loading the system being controlled by the particular circuit breaker. Necessary intimation regarding the date and time of commissioning /loading shall be given to the supplier by the purchaser.

iv) It shall be ensured that there is no possibility of operation by mistake at the time of commissioning.

(18) SITE TESTS:

All routine tests except power frequency voltage dry with stand test on main circuit breakers shall be repeated on the completely assembled breaker at site.

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-414-316-00	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	DM	VK	VK
TITLE	GENERAL TECHNICAL REQUIREMENTS SECTION 3			SIGN			
				DATE	06/07/2023	06/07/2023	06/07/2023
				GROUP	TBEM	W.O. No	
CUSTOMER	UTTARAKHAND JAL VIDYUT NIGAM LIMITED (UJVNL)						
PROJECT	RMU of Chilla HEP (4 X 36MW)						

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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, equipments and services covered under other respective sections 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 hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS:

a)	Customer/ Purchaser/ Owner	UJVN Limited
b)	Project Title	132kV Switchyard for 4 X 36 MW Chilla HEP
c)	Location	5km downstream of Rishikesh Chilla Colony, District: Pauri (Gharwal), 9kms from the city of Haridwar, Uttrakhand
d)	Maximum Pond Level	El.337 m above MSL
e)	Normal Pond Level	El.333 m above MSL
f)	Latitude & Longitude	North 30º04'27" N East 78º17'18" E
g)	Transport Facilities	Nearest Airport at Dehradun (40kms), Nearest Railway station at Haridwar (9kms) Accessible by Road from National Highway NH-334 via Haridwar.
SITE CONDITIONS		
a)	Max. temp.	46.9°C
b)	Min. temp.	2°C
c)	Annual Mean Rainfall (Project Area)	2136.7mm
d)	Maximum Relative humidity	86 %
e)	Minimum Relative humidity	46%
f)	Pollution Severity	Less Polluted
g)	Basic Wind Speed in area	39 m/s
h)	Seismic acceleration	0.36g for maximum Credible Earthquake (MCE) and 0.18g for Design basis Earthquake (DBE)
i)	Seismic zone	Zone-IV

SYSTEM PARAMETERS:

Nominal system voltage	**132 kV**
Highest system voltage	145 kV
Rated continuous current per Ø	1250 A for each bus
Lightning impulse voltage	650 kV (peak)
Switching impulse voltage	650 kV (peak)
Power frequency withstand voltage	275 kV (rms)
Frequency	50 Hz ± 5%
Rated short circuit withstand current	40 kA (rms) for 3 sec
Minimum creepage distance Ø-ground and between circuit breaker terminals	3625mm
System Earthing	Solidly Grounded
Fault Level (DC) both 220V & 48V	15 kA

Note: -

Seismicity: -The project is situated in a seismic zone and falls within Zone IV of the seismic zoning Map of India. Value of peak ground acceleration has been recommended as 0.36g for maximum Credible Earthquake (MCE) and 0.18g for Design Basis Earthquake (DBE).

Wind Load: - The basic wind load as per IS875 (part-3) shall be applied on the vertical projected area, multiplied with the applicable factor for different type of structures.

AUXILIARY POWER SUPPLY:

A.C power supply	415V, 50 Hz, 3-phase 4 wire, neutral earthed with variation in frequency of +/-5% and variation in voltage +/-10%.
D.C. power supply	220V (variation under worst condition from of + 10% to -15%) , 2-wire ungrounded system, 24V, 48V (+10% to -15%), 2 Wire, positive grounded (for communication)

TRANSPORTATION LIMITATIONS:

For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems. Shipments from Manufacturer's work (in case of foreign manufacturer) shall travel to the Port of entry in India, from where these will be transported, after necessary port clearances etc., by the Contractor to Haridwar, which shall be the nearest rail head for the Project, and further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Haridwar and further to Chilla HEP site directly by road transport. However, Indian contractors shall be responsible in all respects for transportation of all materials and equipment up to the project site.

Manufacturers shall consult with the concerned authorities of railways and highways to ensure that their packaging will be such as to permit them to transport the plant and equipment within such imposed limits. Manufacturers shall arrange to deliver the maximum size subassemblies consistent with safe and convenient transport. All materials and equipment etc. arrived at Haridwar will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor. The roads and bridges enroute shall be made suitable for 70R loading capacity. The Contractor is required to carry out survey for obtaining the transportation limitation data on its own.

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.
The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification. It is recognized that the bidders 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 such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.
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.

'Make' of brought-out items are subject to Owner/Purchaser's approval.

The bidder shall furnish relevant details to the Owner/Purchaser for his concurrence before procurement. Makes approved by owner shall only be acceptable.

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

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the more stringent of both shall prevail. All work shall be carried out as per the codes and standards listed out in the description of each equipment/item. Indian Electricity Act and Indian Electricity Rules can be obtained from bureau of Indian Standards. Equipment complying with other internationally accepted standards such as IEC, BS, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force on date of opening of bid and shall clearly bring out the salient features for comparison.
The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956 (latest), and other local rules and regulations.

3.4 MATERIAL/WORKMANSHIP

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood 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. All design calculations, materials, works, manufacturing and testing shall conform to the latest applicable standards.
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 and shall be used throughout the design. 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 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 be interchangeable with, 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.
All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modem practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing

the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.
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 contractor 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 Contractor

3.5 TROPICAL PROTECTION

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.
All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.6 SPACE HEATERS

The space heaters shall be suitable for single phase 50 Hz AC supply from an independent source, which should automatically switch off before starting of unit. However, once the dehumidification unit is switched ON, it shall be controlled automatically with a thermostat. The dehumidification unit shall be designed to avoid hot spot. The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.
One or more adequately rated, thermostatically connected heaters shall be supplied to prevent

condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is 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.

3.7 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 VENTILATION OPENING

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 DEGREE OF PROTECTION

The supplier shall propose the Degree of protection to BHEL/UJVNL for those equipment/Items for which the degree of protection has not been specified in the specification for the approval. The decision of BHEL/UJVNL shall be final. The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/1987, IEC 2147, IS 2063, IEC/ANSI-60529

Type test report for degree of protection test, on each type of the box shall be submitted for approval. The enclosures of the Control Cabinet, Junction boxes and Marshalling boxes panels etc. to be installed shall be provided with degree of protection as detailed here under:

a) Outdoor kiosks and marshalling boxes: IP55
b) MLDB, Sub-distribution boards: IP42
c) Residual current circuit breakers, Socket outlets: IP20
d) The protection class for the luminaries shall generally be as follows:
   For office control room etc.: IP 20 or better
   For all other indoor area: IP 22 or better

For all other indoor area: IP 22 or better

For Switchyard /street light Minimum: IP-65 for Luminaire at 60W or below and IP-66 for Wattage above 60Wprotection and safety as per IEC 60598/IS 10322

e) Protection class of Relay enclosure: IP54
f) Protection class of Protection panel: IP52 minimum
g) 220V DC, UPS switchboards: IP53
h) Installed outdoor: IP-55
i) Installed indoor in air conditioned area: IP-42
j) Installed in covered area IP:52
k) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval. If necessary, the cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture. All panels/cubicles shall have approximately 20% space for mounting of future devices. Door operated interior illuminating lamps, power socket for 240V, 5/15A and communication socket shall be provided in all panels.

3.10 ELECTRICAL EQUIPMENT ENCLOSURES

All electrical equipment, apparatus and devices shall be of suitable design for satisfactory operation under the conditions prevailing at the Site. The equipment shall operate satisfactorily under normal load and voltage variations in accordance with IEC Publications.

The design shall also include all necessary provisions ensuring the safety of the operating and maintenance personnel. All electrical connections and contacts shall be of ample cross section and capacity for carrying continuously the specified currents without undue heating and shall be secured by bolts or setscrews of ample size, fitted with locknuts or lock-washers of approved types.

Unless otherwise expressly stated conductors and all other current carrying parts shall be made from electrolytic grade copper in accordance with approved applicable standards.

Cubicles and other enclosures containing electrical equipment shall be especially treated to prevent corrosion. All cubicles shall be provided with a door switched lighting fixture and a single-phase socket for power outlet.

All interior surfaces of electrical apparatus, enclosures etc. including contactors, relays, and coils, etc., shall be treated in an approved manner to prevent mold growth. Such treatment shall in no way interfere with the proper operation of the equipment either electrically or mechanically.

Bigger assemblies such as switchboards, etc., shall be designed to present suitable transportation devices adapted to the local conditions within the plant.

Unless otherwise specifically called for or described in these Contract Documents all electrical appliances shall conform to the applicable IEC Publications.

CONSTRUCTION REQUIREMENTS

All cubicles and enclosures shall be of good quality standard production subject to approval by the Engineer. Cubicles shall be free floor standing type, of rigid frame covered with removable steel sheets. The frame shall be bolted to the floor. Cubicles mounted in rooms with computer floors shall have their own supporting structures made of steel profiles, being fixed to the concrete floor. There shall be provision and enough space for entrance of cables from above or below as necessary. The cubicles shall be ventilated if needed; in this case, removable filter inserts shall be fitted to the air entrance openings. Provision for cable fastening shall be inside the cubicles and enclosures, and sufficient space from cable fastenings to nearest terminal.

All control and indicating devices such as contactors, circuit breakers, auxiliary relays, indicating instruments, switches etc., shall be functionally displayed in appropriate location. All indicating devices shall be visible with the door closed. The layout is subject to the approval of the Engineer.

If required, flush mounted hinged steel doors with latches shall be available: doors shall be with approved locks. The locks shall be of the same type throughout the plant. All panels and cubicles shall have a uniform appearance.
The indoor cubicles and enclosures shall be of protection class IP42 or higher according to their location. For outside installation, the ingress protection class of cubicles shall be IP65. Cubicles housing electronic cards/ modules such as of unit control boards, control & protection panels, digital governor etc. shall be of protection IP 5X except static excitation equipment (SEE) cubicles shall be IP31. If necessary the cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture especially in the outdoor cubicles such as circuit breaker mechanism & other ODMKs.
All panels/cubicles shall have approximately 20% space for mounting of future devices.
Door operated interior illuminating lamps, power socket for 240V 5 / 15A and communication socket shall be provided in all panels.

WIRING

Unless and otherwise specifically called for or described in these contract documents all electrical appliances shall conform to the applicable IEC standards.
Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 1.52 mm , except as otherwise agreed by the Engineer.
Larger size wiring shall be used where needed for the current carrying capacity requirements.
LT Cables shall have at least 1100 V grade PVC insulation except for 110V DC and telemetering or communication system equipment for which 650V and 300 V ratings respectively are acceptable. Cables shall conform to IEC 60331/ IEC 60332/ IS 1554/ IS 7098 as per applicability. LT power cables single or multicore (2/3/3.5 cores) shall be 1100V grade, heavy duty, FRLS, stranded Aluminum/ Copper conductor, cross linked polyethylene (XLPE) insulated and PVC inter sheathed. Cables for DC system shall be copper only. The control & instrumentation cables shall be multi core, FRLS, colour coded/ numbered, Annealed stranded high

conductivity Copper, insulated with PVC & PVC sheathed. The outer sheath shall be specially formulated PVC compound. For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 2.52mm .
Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in plastic conduits accessible from the front door. The conduits shall not be filled more than 70 %.
Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE wires shall be connected to the earthing bar.
All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Employer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cables having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC 60204 shall be applicable.

TERMINAL BLOCKS

Control circuits & power circuits shall be completely separated by use of divided or separate Terminal Blocks (TB). The screw type modular Terminal block should be manufactured as per IEC-60947-7-1. The insulating material of terminal block should be of polyamide 6.6 meeting V0/V2 flammability Class as per UL94. All metal parts including screws should be of copper alloy. The terminal block should be suitable for mounting on both "DIN" as well as "G" type rail . All metal parts shall be captive & touch proof. The TB shall have screw locking design so that it can withstand vibration level up to 5g and also prevent accidental, loosening of conductors. The terminal blocks shall also have necessary accessories like end clamp, separation plates etc. Unless otherwise specified terminal blocks shall be suitable for connecting following conductors on each side:-

1	All circuits except CT/PT circuits	Minimum of two of 2.5 mm^2 copper flexible
2	All CT/PT circuits	Minimum of two of 2.5 mm^2 copper flexible

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers.
Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short-circuiting and disconnecting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least 20% spare terminals shall be provided on each panel/ cubicle/ box and these spare terminals shall be uniformly distributed on all terminals rows. Terminals shall be marked with printed labels.

GROUNDING

In addition to the grounding through cable screens, all equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm^2 at two different points. In general, all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

PROTECTION DEVICES

For short circuit and overload protection of power and control circuits, moulded case circuit breakers or MCBs shall be used. Outlets from AC (and DC) distribution panels are protected in their respective panels. Power supply system shall be provided with three stage of surge protection (First stage with class A type, Second stage with class B type and third stage with class D type of lightning arrestors) to protect electrical & electronic devices.

MARKING OF EQUIPMENT AND WIRING

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Engineer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.

i) Colour Coding For Electrical Connections Live parts of electrical connections shall be colour coded as follows:

Conductor Designation	**Coding Alphanumeric**	**Symbol**	**Colour**
A.C. network 3 phase	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
A.C. single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green-Yellow
D.C. Network	Positive	a	Red
	Negative	b	Black

ii) Colour Coding for Mimic Diagrams
Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc., shall be colour coded as follows:

S. No.	**Voltage Level**	**Colour**	**Colour Code**
1	HVDC	Crimson Red	No. 540 as per IS - 5
2	400 kV	Signal Red	RAL 3001/ No. 537 as per IS - 5
3	220 kV	Yellow Orange/ Light Orange	RAL 2000/ No. 557 as per IS - 5
4	132 kV & 110 kV	Lemon Yellow	RAL 1012/ No. 355 as per IS - 5

5	66 kV	Golden Brown	No. 414 as per IS - 5
6	33 kV	Olive Green	RAL 6003/ No. 220 as per IS - 5
7	11 kV	Sea Green	RAL 6017/ No. 217 as per IS - 5
8	6.6 kV	Aircraft Blue	No. 108 as per IS - 5
9	3.3 kV	Sky Blue	RAL 5015/ No. 101 as per IS - 5
10	415V & 220V AC	Dark Violet	No. 796 as per IS - 5
11	220V & 110V DC	Graphite Black	RAL 9011

Note: Above colours shall be finally agreed upon during detailed design.

3.11 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents

3.12 RATING PLATES, NAME PLATES AND LABELS

Rating plates and other technical data/informative plates shall either be of the enameled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

The switchyard equipment shall have a rating plate with the information required by relevant IEC i.e. at least the following:

- Manufacturer's name
- Type number
- Serial number
- Rated Voltage
- Rated impulse withstand voltage
- Rated power frequency withstand voltage
- Rated frequency
- Rated current

- Rated short circuit breaking current
- Rated short time current (r.m.s), & duration Each instrument transformer must have its own rating plate with the information as required in IEC 600441 and IEC 60186.

3.13 DRAWINGS

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 Contractor (including those of sub-vendors) shall bear a 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.

After the approval of the drawings, further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, 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. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor’s drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

3.14.1 QUALIFYING REQUIREMENT

As per section-1 of item Specific QR

3.14.2 TYPE TESTS

The offered equipment must have been fully type tested as per relevant IS and/ or other specified International Standards carried out after **30.05.2014**. The type test certificate of prototype manufactured and tested by foreign collaborators of the Bidders at their works shall not be acceptable for indigenously manufactured equipment.

In case the equipment is being, manufactured in India under foreign collaboration, the collaborator's equipment shall have minimum two years' satisfactory operating experience under tropical climate. The offered indigenously manufactured equipment should have been type tested and test report submitted with the tender.

Type tests to be done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in carried out after **30.05.2014**, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.15. COLOUR SCHEDULE

Colour Standard references to major equipment/ system shall be as per the details given below: -

S. No.	Equipment	Colour	Colour Code
1	Governor Cubicles	Oyster White	RAL 1013
2	Local Control Cubicle for Governor	Oyster White	RAL 1013
3	Generator Cover Plates	Oyster White	RAL 1013
4	Braking Control Cubicle	Oyster White with blue band	RAL 1013 & RAL 5012 for band
5	LAVT/NGT/Transformers including Marshalling Box	Light Grey	RAL 7035

6	Bus Duct	Light Grey	RAL 7035
7	HS Oil Unit	Light Grey	RAL 7035
8	Oil Sump Tank	Light Grey	RAL 7035
9	Oil centrifuging & purification system	Light Grey	RAL 7035
10	Turbine (top cover & other equipment in the turbine pit)	Pebble Grey	RAL 7032
11	HS Oil Unit	Light Grey	RAL 7035
12	Oil Pressure Tank	Yellow Orange	RAL 2000
13	Cooling water pumps, cooling water filters & strainers.	Mint Green	RAL 6029
14	Cooling water, conveniences water & drinking water pipelines	Mint Green	RAL 6029
15	Local Control Cubicle for cooling water system, Drainage & dewatering system and emergency flood dewatering pumps	Oyster White with green band	RAL 1013 & RAL 6029 band
16	compressed air pipelines	Light Blue	RAL 5012
17	Air Compressors	Sky Blue	RAL 5015
18	Fire Fighting water Pipelines	Traffic Red	RAL 3020
19	Pressure oil & lubrication oil Pipelines	Yellow Orange	RAL 2000
20	Transformers	Pebble Grey	RAL 7032
21	Outdoor switchyard equipment, junction box, Outdoor Marshalling Kiosk (ODMK) etc.	Pebble Grey	RAL 7032

22	Unit Control Board/ Local Control Boards/ Excitation Panel/ Protection & Control Panels/ indoor marshalling boxes etc.	Oyster White	RAL 1013
23	Power Auxiliary Boards, Distribution Low Voltage Boards	Oyster White with Melon Yellow band	RAL 1013 & RAL 1028 band

The interior of all the cubicles & panels shall preferably have a matt finish unless specified otherwise. The colour scheme shall however be got reconfirmed & approved by the Employer during detailed engineering

3.16 ELECTRICAL EQUIPMENT ENCLOSURES

GENERAL

All electrical equipment, apparatus and devices shall be of suitable design for satisfactory operation under the conditions prevailing at the Site. The equipment shall operate satisfactorily under normal load and voltage variations in accordance with IEC Publications.
The design shall also include all necessary provisions ensuring the safety of the operating and maintenance personnel.
All electrical connections and contacts shall be of ample cross section and capacity for carrying continuously the specified currents without undue heating and shall be secured by bolts or setscrews of ample size, fitted with locknuts or lock-washers of approved types.

Unless otherwise expressly stated conductors and all other current carrying parts shall be made from electrolytic grade copper in accordance with approved applicable standards.

Cubicles and other enclosures containing electrical equipment shall be especially treated to prevent corrosion. All cubicles shall be provided with a door switched lighting fixture and a single-phase socket for power outlet.

All interior surfaces of electrical apparatus, enclosures etc. including contactors, relays, and coils, etc., shall be treated in an approved manner to prevent mold growth. Such treatment shall in no way interfere with the proper operation of the equipment either electrically or mechanically.

Bigger assemblies such as switchboards, etc., shall be designed to present suitable transportation devices adapted to the local conditions within the plant.

Unless otherwise specifically called for or described in these Contract Documents all electrical appliances shall conform to the applicable IEC Publications.

CONSTRUCTION REQUIREMENTS

All cubicles and enclosures shall be of good quality standard production subject to approval by the Engineer. Cubicles shall be free floor standing type, of rigid frame covered with removable steel sheets. The frame shall be bolted to the floor. Cubicles mounted in rooms with computer floors shall have their own supporting structures made of steel profiles, being fixed to the concrete floor. There shall be provision and enough space for entrance of cables from above or below as necessary. The cubicles shall be ventilated if needed; in this case, removable filter inserts shall be fitted to the air entrance openings. Provision for cable fastening shall be inside the cubicles and enclosures, and sufficient space from cable fastenings to nearest terminal.

All control and indicating devices such as contactors, circuit breakers, auxiliary relays, indicating instruments, switches etc., shall be functionally displayed in appropriate location. All indicating devices shall be visible with the door closed. The layout is subject to the approval of the Engineer. If required, flush mounted hinged steel doors with latches shall be available: doors shall be with approved locks. The locks shall be of the same type throughout the plant. All panels and cubicles shall have a uniform appearance.

The indoor cubicles and enclosures shall be of protection class IP42 or higher according to their location. For outside installation, the ingress protection class of cubicles shall be IP65. Cubicles housing electronic cards/ modules such as of unit control boards, control & protection panels, digital governor etc. shall be of protection IP 5X except static excitation equipment (SEE) cubicles shall be IP31. If necessary the cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture especially in the outdoor cubicles such as circuit breaker mechanism & other ODMKs. All panels/cubicles shall have approximately 20% space for mounting of future devices.
Door operated interior illuminating lamps, power socket for 240V 5 / 15A and communication socket shall be provided in all panels.

WIRING

Unless and otherwise specifically called for or described in these contract documents all electrical appliances shall conform to the applicable IEC standards.

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 1.5 mm^2 , except as otherwise agreed by the Engineer.

Larger size wiring shall be used where needed for the current carrying capacity requirements.

LT Cables shall have at least 1100 V grade PVC insulation except for 110V DC and telemetering or communication system equipment for which 650V and 300 V ratings respectively are acceptable. Cables shall conform to IEC 60331/ IEC 60332/ IS 1554/ IS 7098 as per applicability. LT power cables single or multicore (2/3/3.5 cores) shall be 1100V grade, heavy duty, FRLS, stranded Aluminium/ Copper

conductor, cross linked polyethylene (XLPE) insulated and PVC inter sheathed. Cables for DC system shall be copper only. The control & instrumentation cables shall be multi core, FRLS, colour coded/ numbered, Annealed stranded high conductivity Copper, insulated with PVC & PVC sheathed. The outer sheath shall be specially formulated PVC compound.

For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 2.5 mm^2 .
Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in plastic conduits accessible from the front door. The conduits shall not be filled more than 70 %.
Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE wires shall be connected to the earthing bar.

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Employer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cables having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC 60204 shall be applicable.

TERMINAL BLOCKS

Control circuits & power circuits shall be completely separated by use of divided or separate Terminal Blocks (TB).

The screw type modular Terminal block should be manufactured as per IEC-60947-7-1. The insulating material of terminal block should be of polyamide 6.6 meeting V0/V2 flammability Class as per UL94. All metal parts including screws should be of copper alloy. The terminal block should be suitable for mounting on both “DIN” as well as “G” type rail . All metal parts shall be captive & touch proof. The TB shall have screw locking design so that it can withstand vibration level up to 5g and also prevent accidental, loosening of conductors. The terminal blocks shall also have necessary accessories like end clamp, separation plates etc. Unlewss otherwise specified terminal blocks shall be suitable for connecting following conductors on each side:-

1	All circuits except CT/PT circuits	Minimum of two of 2.5 mm2 copper flexible
2	All CT/PT circuits	Minimum of two of 2.5 mm2 copper flexible

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely

separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers.

Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short-circuiting and disconnecting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least 20% spare terminals shall be provided on each panel/ cubicle/ box and these spare terminals shall be uniformly distributed on all terminals rows. Terminals shall be marked with printed labels.

GROUNDING

The Contractor shall connect all equipment included in the scope of delivery to the grounding system as described in chapter on Grounding System.

In addition to the grounding through cable screens, all equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm2 at two different points. In general, all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

MARKING OF EQUIPMENT AND WIRING

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Engineer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.

i) Colour Coding For Electrical Connections

Live parts of electrical connections shall be colour coded as follows:

Conductor Designation	Coding Alphanumeric	Symbol	Colour
A.C. network 3 phase	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
A.C. single phase	Phase	P	Red

	Neutral	N	Black
	Earth	E	Green-Yellow
D.C. Network	Positive	a	Red
	Negative	b	Black

ii) Colour Coding for Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc., shall be colour coded as follows:

S. No.	Voltage Level	Colour	Colour Code
1	HVDC	Crimson Red	No. 540 as per IS - 5
2	400 kV	Signal Red	RAL 3001/ No. 537 as per IS - 5
3	220 kV	Yellow Orange/ Light Orange	RAL 2000/ No. 557 as per IS - 5
4	132 kV & 110 kV	Lemon Yellow	RAL 1012/ No. 355 as per IS - 5
5	66 kV	Golden Brown	No. 414 as per IS - 5
6	33 kV	Olive Green	RAL 6003/ No. 220 as per IS - 5
7	11 kV	Sea Green	RAL 6017/ No. 217 as per IS - 5
8	6.6 kV	Aircraft Blue	No. 108 as per IS - 5
9	3.3 kV	Sky Blue	RAL 5015/ No. 101 as per IS - 5
10	415V & 220V AC	Dark Violet	No. 796 as per IS - 5
11	220V & 110V DC	Graphite Black	RAL 9011

3.17 PACKING

The Contractor shall provide such packing of the Goods as is required to prevent damage or deterioration during transit to their final destination i.e. Chilla HEP site as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit

and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall be taken into consideration, where appropriate, the remoteness of the Good's final destination and the absence of heavy handling facilities at all points in transit.
Suitable lifting lugs should be provided in heavy consignments and clear instructions be marked on the package for handling.

All electrical parts shall be carefully packed in high-pressure polyethylene foils where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

All bright parts shall be thoroughly protected from rust during transit. Each package shall contain a packing list in polythene cover and six copies shall be sent to the Employer. All points shall be marked to facilitate erection.

Large articles, which are not packed in cases, shall have all screwed holes, plugged suitably and machined surfaces properly protected. Weight and size limitation for transport shall be ensured by the Contractor.

The Contractor will be required to make separate packages for each consignment and shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:
a. Consignee :
b. Contract No. :
c. Package number :
d. Description :
e. Item number (if applicable) :
f. Net and gross weight :
g. Volume :
h. Country of Origin :
i. Port of entry :

3.18 DELIVERY, INSTALLATION AND COMMISSIONING

TRANSPORTATION LIMITATIONS:
For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems. Shipments from Manufacturer's work (in case of foreign manufacturer) shall travel to the Port of entry in India, from where these will be transported, after necessary port clearances etc., by the Contractor to Haridwar , which shall be the nearest rail head for the Project, and further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Haridwar and further to Chilla HE Project site directly by road transport. However, Indian contractors shall be responsible in all respects for transportation of all materials and equipment up to the project site. The contractor shall consult with the concerned authorities of railways and highways to ensure that their packaging will be such

as to permit them to transport the plant and equipment within such imposed limits. Manufacturers shall arrange to deliver the maximum size sub-assemblies consistent with safe and convenient transport. All materials and equipment etc. arrived at Haridwar will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor. The roads and bridges en-route shall be made suitable for loading capacity.

All components shall be so designed and constructed as would enable easy assembly of components at works and at the same time permit easy transportation. The weights and sizes of the components/packages shall be within the permissible transport limits for the project site.

PACKAGING, HANDLING AND SITE STORAGE:

The Contractor shall pack all the consignment in sea worthy packaging, wherever required, strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage. The packaging and storage of electronic equipment shall be strictly in accordance with internationally accepted standards. Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

INSTALLATION PROCEDURE:

The contractor shall submit six copies of all detailed programs and the procedures to be adopted for disassembly, erection/installation, testing and commissioning well in advance, before start of erection activates/installation, for approval of the Employer. The installation procedure shall also have a section “site quality assurance plan” containing erection data sheets for various components. These sheets should specify site measurements/inspection required to be made for ensuring proper installation.

SPECIAL TOOLS AND TACKLES

The bidder shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

INSTALLATION & FIELD TESTING

The Contractor has to do all the work related to disassembly, assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumable for performing installation, testing and pre_commissioning shall be proved by the Contractor. The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance. The Contractor shall provide and install the concrete inserts/embedment; support steels and/or components such as discharge ring, draft tube cone etc. and coordinate between both E&M as well as civil activities within the scope of the tender,

keeping both the activities synchronised. All installation for foundation shall be verified and accepted by the Employer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountains, conduits, cabling, panels etc. Chipping of concrete and, or taking support from reinforcement bars shall not be allowed. Casting of new concrete blocks if required shall be in the scope of the contractor.
The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling or equipment and plant accessories shall be the responsibility of the Contractor. The supply of all type of consumables and other materials required for installation etc. for all equipment shall be in the scope of contractor. The contractor shall furnish a complete outline of the proposed methods and field procedures to be followed for all the equipment testing including a list of equipment and instruments to be used, to the Engineer for review not later than 60 days prior to the date of testing of each equipment.
The contractor shall provide all necessary materials and labour for preparing all the field tests on the equipment. All test equipment and instruments shall be furnished by the contractor and will remain the contractor's property after the fulfilment of all field tests.
The contractor shall furnish a complete report of the field tests carried out on all equipment.

3.18.1 HANDLING, STORING AND INSTALLATION

Manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.
Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.
Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.
The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.
The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.19 QUALITY ASSURANCE PALN

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.20 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.21 DOCUMENTATION

3.20.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.
The supplier shall necessarily submit all the drawings / documents unless anything is waived.
All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.20.2 DRAWINGS

All drawings submitted by the Contractor 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's and materials, clearances and spaces required for installation and interconnection between various portions of equipment's and any other information specifically requested in the specifications.

Vendor to provide calculation of power requirement for operating mechanism of breakers and other switches like **isolators.**

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, contract no., and the name of the Project. 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.
Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.
All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.21.1 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
	Approval or comments	Within 3 weeks of receipt of resubmission
	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

3.21.2 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

Drawings
Guaranteed Technical Particulars
Type Test Reports
Manufacturing Quality Plan

DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	11	13	05
2	Drawings "As Built "	-	-	13	
5	Type Test Reports	1	11	13	
7	Erection Manuals	-	11	13	
9	Operation and Maintenance Manuals	-	11	13	
13	Manufacturing Quality Plan	1	11	13	
15	Field Quality Plan	1	11	13	
17.	Inspection Test Reports	-	-	13	

Drawings will also be submitted in in AUTOCAD or any other CAD package along with conversion files for all major items.
Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top .

3.22 : Please refer attached document- **VOLUME III-A GENERAL TECHNICAL SPECIFICATIONS (GTS)**

VOLUME III-A
GENERAL TECHNICAL SPECIFICATIONS (GTS)

January, 2019

VOLUME III A
General Technical Specifications
Table of content

1. GENERAL REQUIREMENTS

1.1 GENERAL

The Contractor shall strictly observe this General Technical Specification in conjunction with the other sections of these specifications. He shall carry out all works in a skilled and workman like manner in conformity with modern methods of engineering. All design; calculations, materials, works, manufacturing and testing shall conform to the latest applicable standards.

In addition, the Contractor shall conform to all applicable regulations regarding the execution of construction and installation work, and shall follow all instructions issued by the competent Authorities, and the Engineer.

The other technical specifications shall take precedence over the general technical specifications in case of any contradiction or conflict.

Clause number cross-references refer to the Section in which they occur unless stated otherwise.

1.2 SCOPE OF WORK

The scope of work covered by these Electro-Mechanical Works-General Technical Specifications is established in the other sections (Section 7 to Section 14). In addition to this, the Contractor shall prepare the detailed design, construction and installation drawings as well as calculations, material specifications, operating and maintenance instructions, etc., for the works as stipulated in the other sections of Specifications.

The Contractor shall refurbish, design, manufacture, supply, erect, test & commission and hand-over to Owner and guarantee for Twenty Four (24) months after commissioning all works complete in every respect with all necessary accessories for reliable, efficient and trouble free continuous operation as per the detailed technical specifications.

These Specifications include the performance of all works and the provision of all labours, materials, permanent and temporary equipment, tools, accessories for transport to the site, including loading, unloading, if necessary reloading in the port of arrival, intermediate storage, protection of the Works from the effects of the weather, cleaning, drying, storage at site and preservation related works, complete installation, painting, testing and commissioning of all works and accessories of the works.

The Contractor shall make competent and experienced staff available for the training and assistance of the operating staff during commissioning and trial operation and, if required by the Employer, for a period after completion of the trial operation which shall be agreed separately.

The Contractor shall supply the Operation and Maintenance Instruction Manuals in a number and at a time as stated in the General and Special Conditions of Contract.

1.3 STANDARDS

Although European or IEC standards for design, stipulated testing, workmanship material and Works have been mostly stipulated in these specifications as a basis of reference, other standards and recommendations of standard international organizations will be acceptable provided they ensure equal or higher quality than those specified, and provided, furthermore, that the Contractor submits for approval detailed standards which he proposes to use.

When IEC or ISO Recommendations or other Standards are referred to, the Edition shall be that current at the time of issue of Tender Documents, and any Amendments issued till then.

If requested by the Engineer, the Contractor shall supply at his own expense three copies in English and one in the original language of any national standards, if these are not English, which are applicable to the Contract.

Standard publications issued by the following organizations of standardization are considered as acceptable standards for the works subject to acceptance of the Employer:

1.3.1 Standards for General Application

AGMA	American Gear Manufacturers Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing of Materials
AWS	American Welding Society
BS	British Standards
CCITT	International Telephone & Telegraph Consulting Committee
CECT	European committee for Manufacturing of Boilers & Kindred Steel Structures
CMAA	Crane Manufacturers Association of America
DIN	Deutsche Institute for Normung
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IIW	International Institute of Welding
IPCEA	Insulated Power Cable Engineer's Association

IS	Indian Standards
ISO	International Standards Organisation
JEC	Standards of the Japanese Electro-technical Committee
JIS	Japan Industrial Standards
KS	Korean Industrial Standards
NEMA	National Electrical Manufacturers Association
VDE	Verein Deutscher Elektroingenieure
VDI	Verein Deutscher Ingenieure
SIS	Swedish Standards Institute
USAS	United States of America Standards Institute

"Not withstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable“

1.3.2 Basic Design Standards

ISO System for Limits and Fits,	ISO/R286-1963
Part I, General Tolerances and Deviations	ISO/R1829-1975
Permissible Machining Variations in Dimensions without Tolerance Indication	ISO/2786-1973
Screw Threads	ISO 68-1973 ISO262-1973 ISO/R724-1978

1.3.3 Manufacturing and Testing Standards

Methods and Definitions for	
Mechanical Testing of Steel Products	ASTM-A370
Tension Testing of Metallic Materials	ISO/R82-1959
Notched Bar Impact Testing of Metallic Materials	ASTM- E23 and ISO/R83-1976

Bend Test for Steel	ISO/R85-1959
Liquid Penetrant Inspection	ASTM-E165
Recommended Practice for	ASTM- E94
Radiographic Testing	
Ultrasonic Examination of	ASTM-A388
Heavy Steel Forgings	
Guided Bend Test for Ductility of Welds	ASTM-E190
Welders' Qualification Tests	AWS (American Welding Society) Group B,
	DIN EN 287
Preparation of Steel Surfaces for	
Painting by Sand blasting	SIS 05-5900
Designation of Degree of Rusting of Painted Surfaces	DIN53210
Certificates of Material Testing	DIN50049

"Notwithstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable".

1.3.4 Material Standards

ASTM (American Society for Testing Materials), AISI (American Iron and Steel Institute), DIN (German Industrial Standards) and BS (British Standards) are approved standards for the supply of materials.

Material tests according to DIN 50 049-3.1 C shall be provided for all important parts of the equipment such as: steel plates for parts under hydraulic pressure, all major castings (runner, shut-off valve, etc.), Large forgings (turbine and generator shaft etc.), high stressed large bolts etc.

For less important parts, certificates according to DIN 50 049-2.3 are acceptable.

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and of the classifications and grades in conforming to the latest issue of conforming the respective ASTM, AISI, DIN or BS standard. Materials conforming to other standards may be used if approval by the Engineer has been obtained. Material specifications, including grade or class data, shall be shown on the appropriate detailed drawings submitted for review.

For using stock material not specifically prepared for the works under this Contract, the Contractor shall submit evidence that the material complies with approved standards and that the material is suitable for the intended use.

The materials shall be carefully selected for the intended purpose and with due consideration of the site conditions and the tropical environment. Higher-grade material shall be used where ordinary material is insufficient.

"Notwithstanding reference made to various standards all equipment and works shall be as per provisions and requirements of relevant and latest Indian Standards and shall be acceptable“.

1.3.5 Electrical Standards

The following basic standards for electrical works or any other equivalent approved standards shall be applied:

IS (Indian Standards)

Standards issued by IEC (International Electro technical Commission)

Standards issued by CCITT (International Telephone and Telegraph Consultative Committee)

For specific standards see the Particular Technical Specifications.

1.4 UNITS OF MEASUREMENTS

The international SI-system of units shall be used in documents, calculations, correspondence, drawings, etc., relevant to the Tender and the subsequent Contract.

1.5 WORKS IDENTIFICATION SYSTEM

An approved, uniform Works identification system shall be applied for all Mechanical, Electrical and Instrumentation and Control (I&C) Works to be agreed upon during detailed design.

1.6 TIME SCHEDULE

According to the relevant articles in the General and Special Conditions of Contract, the progress of the work shall conform to the basic Programme of Work on which the Contract is based.

The "Programme" to be submitted shall include the following information

Design work

Shop work

Testing and inspection of works

Transport to the Site

Storage at site

Preparations at the Site

Interdependence with works of other Contractors

Erection and commissioning

Acceptance testing

Handing over

Trial operation for fifteen (15) days

Removal of erection equipment and clearing of the Site

The Contractor shall pay particular attention to the dates established for the submission of installation and foundation drawings with loading data, anchoring details, recesses, block-outs etc.

2. TECHNICAL DOCUMENTS

2.1 GENERAL

This clause specifies the general scope and gives a definition of the documents which, together with those listed in the Technical Specifications, shall be delivered by the Contractor to the Engineer within the periods, and in a number and quality as specified in the General and Special Conditions.

The Engineer reserves the right to request the Contractor for additional documents as may be required for proper understanding and definition of constructional, operational, co-ordination or other matters.

All documents to be supplied shall be submitted in accordance with the agreed programme so that any comment made and change requested by the Engineer can be taken into account before starting the manufacture in the workshop and/or erection or installation at the Site.

If the Contractor fails to submit such documents, then the later execution of changes requested by the Engineer and the resulting additional cost and/or delays shall be the Contractor's responsibility and liability. The Contractor shall not be relieved of his responsibility

and guarantee after drawings and computations have been approved by the Engineer.

The preparation of drawings, computations or other technical documents shall not be sublet by the Contractor without the written authorization of the Engineer. In such a case the Contractor shall be fully responsible for such drawings, computations and other technical documents as if they were done by him.

On drawings, catalogue sheets or pamphlets of standard Works submitted to the Employer or Engineer in charge, the applicable types, paragraphs, data, etc. shall either be marked distinctively or the non-applicable parts shall be crossed out. Documents not marked in such a manner will not be accepted and approved by the Engineer-in-Charge.

For proper understanding of the documents, additional descrip-tions/explanations shall be given on these documents or on separate sheets if so requested by the Employer. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

Each device appearing on any document (drawing, diagram, list, etc.) shall clearly be designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusion. All documents shall have a uniform title-block and agreed by the Engineer in charge. Beginning with the very first submittal to the Engineer in charge, the Contractor's drawings shall bear a serial number corresponding to a drawing classification plan to be agreed upon by the Contractor and the Engineer in charge.

Revised technical documents replacing previously submitted documents shall be marked accordingly. Also, the revised part in the Document itself shall be marked clearly with cloud mark. Annex No. 3 of this Section specifies the documents to be supplied and the purpose, namely "FOR APPROVAL" (A) or "FOR INFORMATION" (I), respectively.

Any comment given by the Engineer on a "I" type drawing shall have the same effect as if it were given on a "A" type drawing.

2.2 DRAWINGS

2.2.1 Loading Drawings

For all larger pieces of Works which, due to their dimensions and/or weight and transport limitations, will require special means for their transportation, the Contractor shall submit binding loading drawings indicating dimensions, weights, etc., of the respective pieces of Works and the necessary trailer for its transportation to the site.

2.2.2 Foundation Drawings

If a piece of Works requires its own foundation or needs a special area for installation, the Contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

If conduits are to be installed in the foundations, the relevant information such as diameter, length, and purpose shall be indicated on the drawings.

2.2.3 Arrangement Drawings

All arrangement drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works (constructions, machines, complete switchgears, control panels, instrument cubicles, etc.), civil constructions (buildings, rooms, foundations, ducts, etc.) and reserved areas (for pipes, cables, lines, etc.) in relation to each other and to agreed co-ordinates and boundaries. Such drawings shall be prepared for the whole plot, for separate plots and for each building (building, hall, room, ducts and trenches, etc.).

The Arrangement or Layout Drawings of electrical and instrumentation and control equipment shall indicate the location of all apparatus wherever used, i.e. in or on machines, control boards, switchboards, cubicles, control desks and panels, etc. The apparatus shall be denominated with the same standardised abbreviations as used in all other documents.

2.2.4 Outline Drawings

The Outline Drawing shall show all elements and the main dimensions of individual components where necessary in plan view, cross-section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

2.2.5 Design Drawings

The Design Drawings shall include the shop drawings, assembly drawings, erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract.

The drawings shall, where applicable, substantially conform to the Tender Drawings and shall show:

- - Details of manufacturing and treatment of major single work pieces specially manufactured for this Contract
- - Assembly of the Works in plan and elevation with main dimensions
- - Sub-assembly of the principal components of the Works with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings
- - Sub-assemblies in which the Contractor proposes to ship the Works
- - All necessary details of the parts connecting to the Works supplied by others
- - Location and sizes of auxiliary connections for oil, grease, water, air, electrical power etc.
- - Location and size of the instruments and accessories provided Methods of lubrication and sealing
- - Instructions for heat treatment, pressure tests, surface preparation and anti-corrosive protection
- - Full details of parts for which adjustment is provided or which are subject to wear
- - Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

2.2.6 Installation Drawings

The construction, mechanical, electrical and I & C Installation Drawings shall provide detailed information on the disposition of the various items of a system (e.g. lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, pipes, valves, pumps, compressors, etc.) and of the piping and wiring respectively included in the installation or assembly. They shall be based on dimen-sion drawings of cubicles, rooms, buildings or areas containing the Works.

2.3 DIAGRAMS

For electrical diagrams general reference is made to IEC 113-1.

"Notwithstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable“.

2.3.1 Single-Line Diagrams

This is a simplified diagram of the essential electrical Works and their interconnections. Each circuit shall be represented by a single line only. It shall contain all required technical information of the Works represented, e.g. voltage, current, capacity, short-circuit level, ratios, voltage variations, positive and zero sequence impedances, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc. as applicable.

Single-line diagrams of individual main components and switchboards shall additionally show the control, indicating, measuring, metering, protection, automatic, and other auxiliary electric devices separated for each individual installation site and location as applicable:

Local:	Switchboard control compartment, switch compartment, cable termination compartment, etc.
Remote:	Control room (from workstation). Unit control Board (from MMI) Relay (in auxiliary relay cubicle, UCB, LCB, protection cubicle) Separate energy meter cubicle.

Furthermore, the applied recommended setting of adjustable devices (protection and control elements, time relays, etc.) shall be indicated.

2.3.2 Circuit Diagrams

The Circuit Diagrams shall show the power circuits in all the phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Works or circuits with all required technical information.

The control part shall be subdivided into separately drawn "current paths", each showing all its components regardless of their actual physical location. The individual circuits are to be drawn in a straight-line sequence, avoiding line crossings. The current paths (to be designated by numbers) shall be drawn starting from two horizontal lines, which represent the control voltage source. All devices belonging to the Works or forming part of the Works or control devices shall appear between these two lines.

Contact developments of the installed switches, contactors, relays and other apparatus which appear in the diagram shall be shown below the respective contactor coil, indicating by means of numbers and, if not on the same, also the page No., the current path in which the corresponding contact has been used.

Interconnections to other circuit diagrams shall be clearly marked by means of dotted line separations and the corresponding functional designation.

The power circuit portion of the installation shall be drawn at the left side of the drawing.

Circuit diagrams shall also contain all terminals and their correct designations. Terminals grouped together to terminal blocks of switchboards, distributors, etc. shall be shown on the circuit diagrams in one fictitious horizontal line surrounded by demarcation lines. If, for any reason, the current paths of circuit diagrams must be separated, the corresponding counter terminal has to be indicated by all means.

The representation of electrical Works and control circuits shall not be terminated at the limits of the scope of supply, but has to be extended beyond this limit by all switchgear, protective, measuring and monitoring equipment required for full comprehension of the whole circuit. All terminals and functions of Works to be supplied by others shall be taken over as well.

Standard Circuit Diagrams are patterns of circuit diagrams which have been standardised with regard to scope, arrangement, representation and allocation of Works with the aim of simplification and easy surveillance of electrical circuitry.

2.3.3 Block Diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter-relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

Wherever possible, a Block Text Diagram may be prepared, consisting essentially of explanatory texts enclosed in outlines which are linked by lines showing the functional relationships that exist between the various parts of an installation, Works or circuit.

2.3.4 Logic Diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realisation. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

2.3.5 Terminal Diagrams

Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.

The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

- Terminal number of terminal board with targets (terminal number and current path) of incoming and outgoing cables and wires.
- Cable designation
- Type of cable
- Number and cross-section of conductors
- Assignment of conductors
- Number of spare conductors
- Approx. length of cable and its destination.

2.3.6 Protection Co-ordination Diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays.

Co-coordinated tripping curves of related protection devices.

Setting of the protection devices.

2.3.7 Emergency Shutdown Diagram

This diagram shall show the sequential steps and interdependencies during emergency closure.

2.4 SPECIFICATIONS

2.4.1 Material Specifications

Such specifications shall be prepared for all principal Works and installations. They shall describe the performance (design, material, dimensions, corrosion protection, etc.) of the Works and include a list of components providing information on the manufacturer, type and technical data to obtain the following:

- Full information on the Works, completing the general requirements fixed in the Tender Specification by the data/information of the specific manufacture.
- Proof of compliance with Contract Specification.

For standard Facilities (for example valves, switchgear, control gear, relays, transmitters, indicators, lighting fittings, etc.) catalogues or pamphlets shall be submitted.

The technical data of electrical Works shall include as a minimum:

- Max. Permissible ambient conditions (temperatures, humidity)
- Rated current and rated output/capacity
- Same data as above under specified severest site conditions
- Rated voltage and ratio or regulation/setting range
- Max. Service voltage (acc. to IEC)
- Power frequency and impulse withstand voltages
- Type and code No. of protection relays and of instantaneous or thermal releases directly attached to circuit breakers and contactors
- Power requirements for each voltage level (A.C./D.C.).
- Specific requirements are described in the following paragraphs.

2.4.1.1 Motor Specifications

The motor specifications shall include the thermal motor characteristic both for cold and hot condition, the start-up characteristic when running with the driven machine and all data required for selection of the appropriate motor protection relay (both for cold and hot condition) and for locked rotor protection. Construction type, class of protection and insulation shall also be given.

2.4.1.2 Cable Specifications

The General Cable Specification shall include the calculation of the de-rating factors for the individual modes of installation at applicable ambient temperatures and grouping of cables, and furthermore, for each cross section:

- The rated current carrying capacity
- The maximum Short-circuit capacity
- The voltage drop
- Type, insulation serving, armouring and sheathing of cable
- Type, description and catalogue/pamphlet of cable termination.

Separate specification(s) shall be prepared for cable trays, conduits, supporting structures and other accessories.

2.4.1.3 Measurement and Control Apparatus Specifications

The accuracy of performance with respect to variable ambient conditions and the power supply requirements shall be included.

2.5 LISTS AND SCHEDULES

2.5.1 Motor Lists

The motor lists shall be prepared according to the power distribution boards. The motors are connected to, and shall contain at least the following information/data:

- Works identification number
- Description
- Manufacturer, type, rated data of driven machine
- Manufacturer and type of electric motor/consumer
- Rated capacity
- Service factor (ratio between motor output and power requirement of the driven machine)
- Rated speed
- Rated voltage
- Rated current
- Ratio of starting current to rated current
- Ratio of pull-out torque to rated torque
- Power factor at rated capacity
- Efficiency at rated capacity
- Power consumption at machine design loading
- Total weight
- Design/enclosure/cooling (acc. to IEC)
- Duty (continuous/intermittent/start-up)
- Starting method/permissible starting frequency
- Denomination of feeder
- Motor protection
- Applicable Standard Circuit Diagram (Category)
- Maximum number and overall diameter of power cable(s)
- Manufacturer and type of bearing(s)
- Manufacturer, type and quantity of lubricant, service interval
- Manufacturer, type, number, size, spring pressure and service interval of brushes (if applicable).

2.5.2 Motor Starter Lists

The motor starter lists shall include all starters and contactors used for motors and contain the following technical information as a minimum:

- Works identification number

- Electrical design data as nominal and actual current rating, voltage rating, coil rating, making and breaking capacity, mode of operation
- Maximum power cable size
- Maximum control cable size
- Current transformer ratio, class and capacity
- Type of protection relaying and catalogue number
- Setting of protection relays and maximum continuous rating of the protected circuit
- Type and current rating of the back-up fuses/MCBs for the main and control circuits.

Note: Motor Starter Lists can be substituted by part lists, already forming part of switchgear manuals

2.5.3 Cable Lists/Interconnection Lists

The Cable Lists shall include for each individual cable the following as a minimum:

- Cable number, in accordance with Identification System.
- Cable type
- Rated voltage
- Number and size of conductors
- Overall diameter
- Cable termination at each end
- Connection point at each end with cubicle/Works identification and terminal numbers
- Cable routing

In case interconnecting cubicles are used, the lists shall be prepared to show:

- Cable termination for incoming and out coming cables
- Interconnection wiring

2.5.4 List of Measurements

This list shall indicate all measurements, local as well as remote, and shall contain at least:

- Item/code number, function code
- Description and denomination of measuring loop
- Data of tapping point
- Data of local devices (as detectors, instrument transformers, transmitters)
- Data of remote devices.

2.5.5 Alarm Lists

These lists shall indicate all alarms and shall contain at least:

- Item/code number and function code
- Description and denomination of alarm
- Data of alarm detector (contact) referring to applicable circuit diagram
- Data of alarm annunciator (location and clear text labeling)

2.5.6 List of Final Control Elements

This list shall indicate all control actuators and control valves and shall contain at least:

- Item/code number
- Data of pipe and valve connections
- Data of valve layout
- Rated power

2.5.7 Workshop Test Schedules

Individual Workshop Test Schedules shall be prepared for Works/installations (such as pipes, cranes, machines, switchgears, control gear, cables) and shall contain at least:

- Works identification number
- Manufacturer
- Place of manufacture
- Place of test
- Date of test
- Objective of test (all individual tests)
- Standards applied
- Certification
- Inspection (by Engineer / Independent Test Authority / Contractor/ Subcontractor)
- Release for shipment
- Remarks

On the above schedule or on separate sheets the Test Procedure shall be specified giving for each test item (kind of test) a description, test method / Standards, used instruments, sample/routine test, test judgment.

2.5.8 Site Test Schedules

Testing at site shall include tests specified in the Technical Specifications and any tests recommended by the manufacturers as per their standard practices.

2.5.9 List of Tools and Appliances

Lists of Tools and Appliances shall detail for all tools and appliances included in the scope of supply:

- Item and code number
- Description
- Quantity
- Weight
- Gross storage requirements (separate for open-air, indoor, air-conditioned) for individual component sets.

2.5.10 Spare Part Lists

Spare part lists shall detail for all spare parts included in the scope of supply:

- Detailed drawing (where possible)
- Item and code number
- Description
- Quantity
- Weight
- Gross storage requirements (separate for open-air, indoor, air-conditioned) for individual component sets.

2.5.11 List of Works Identification Numbers

This list shall contain the identification numbers of Works in alphanumeric order and for each of them a description (the defined Works denomination, for example as written on the Works label) and the location (short definition of outdoor area and level elevation or building/room with elevation and room number).

2.6 CALCULATIONS

In addition to the drawings or whenever the contractual documents do so require, the Contractor shall submit to the Engineer for checking, the appropriate calculations for determining the main sizes, stress levels, dimensions and operational characteristics, safety factors, clearly indicating the principles on which the calculations were based. The calculations shall include the formulae, standards, test results, basic assumptions, etc. Submission of computer calculations without baseline information such as derivation of the calculation method,

applied formulas, definition of variables and constants, explanation of abbreviations etc., will not be accepted.

2.6.1 Short-Circuit Calculations

Short circuit calculations showing various steps shall be provided in accordance with VDE Standard 0102, part 1 / IEC 60909. In case, the contractor intends to submit the same in ETAP software, a licensed copy of the said software shall also be provided by the contractor to the owner.

2.7 INSTALLATION AND COMMISSIONING PROCEDURES

2.7.1 Installation Procedures

The installations procedures shall describe in sequential steps the erection of major equipment and shall contain sufficient details such as equipment preparation on erection bay, handling of large and heavy pieces, leveling, anchoring, site welding, site painting, erection checks, site pressure tests, site flushing and cleaning of hydraulic systems, alignment and run out checks to allow the engineer/employer to plan and supervise the Works at site, if required.

2.7.2 Pre-Commissioning Tests and Procedures

Pre-commissioning tests and procedures shall be described in sequential steps for the pre-commissioning of all electrical and mechanical equipments and shall also contain sufficient details viz. checking of installations, ratings, cable terminal checking and operation test of all auxiliary equipments etc.

2.7.3 Commissioning Procedures

The commissioning procedures shall sequentially and in sufficient detail describe activities and tests for all systems covered by the Contract Document.

2.7.4 Commissioning Test

Commissioning acceptance tests shall be carried out, on all generating units to verify the rating characteristics of generating units and other equipment's in accordance to relevant standards. The complete field acceptance test reports shall be prepared by the Contractor and submitted to the Employer for approval.

2.7.5 Test Run

The test run on generating units shall be carried out as per relevant provisions of IEC standards.

2.8 OPERATION AND MAINTENANCE MANUALS

2.8.1 Contents

The Operation and Maintenance Manuals shall be provided in Ten (10) copies along with CD-ROM (three sets), and shall contain the following information in sufficient detail to enable the Employer to maintain, dismantle, reassemble, adjust and operate the Works with all its items of Works and installations:

- Table of Contents
- List of Illustrations
- Introduction

The Introduction shall contain:

- A brief general description of the Works items
- A brief description of the use of the Works items
- Definitions of technical terms used in subsequent graphs of the instruction book
- A complete list of all items used in accordance with the Works Components Identification System.
- Detailed Description

Detailed description shall contain a complete and accurate description of the Works, all components and ancillaries, their assembling and dismantling. An accurate list stating clearances, tolerances, temperatures, fits, etc. shall be included.

- Operating Principles and Characteristics

A brief summary of the technical operating principles of the Works, including diagrams, circuit diagrams, sequence diagrams, piping, etc.

- Operating Instructions

The instructions shall be accurate and easy to understand, and shall contain the sequence of individual manipulations required for operation. The information shall be presented in such a manner that the contents of this paragraph can be used for instructing personnel in the operation of the Works. Tables, lists and graphic presentations should be used whenever possible for making the description readily understandable. An appropriate trouble-shooting list shall be included in this chapter.

- Testing and Adjustment

The entire testing and adjustment procedure required for the Works after overhauls and during operation shall be described.

- Maintenance Instructions

This section is divided into six parts:

1) Preventive maintenance, indicating the inspections required at regular intervals, the inspection procedure, and the routine cleaning and lubricating operations, the regular safety checks and similar steps.

- The maintenance instructions shall include a tabular (or in other approved form) summary of the required activities sorted according to
- Daily
- Weekly
- Monthly
- Quarterly
- Yearly
- (Or other) cycles as applicable.

This document shall provide the maintenance engineer with brief and yet fully comprehensive information including all references to the applicable, detailed service and maintenance instructions.

2) Repair and adjustment, describing the inspections, fitting and dismantling of parts, fault tracing as well as repair and adjustment procedures.

3) Spare part lists, containing all the necessary data for ordering spare parts. These lists shall include all spare parts, those to be supplied and those not to be supplied under the present Contract. Detailed drawing for each item of spare parts shall be supplied. The above list should include minimum and maximum quantities of spares to be maintained by the project.

4) Tool lists, containing all necessary data for identification of tools to be delivered under the present Contract.

5) List of suppliers and alternative suppliers and addresses.

6) As-built drawings

2.8.2 Performance

Each drawing aforementioned shall have a uniform size. The final size of drawings for the Operation and Maintenance Manual shall be decided by the Engineer-in-charge. Catalogue sheets, illustrations, printed specifications, etc., shall be checked and prepared by the Contractor in such a way that the figures, statements and data valid for the delivered sizes and types of the Works concerned are clearly marked. All figures, statements and data valid for sizes and types not delivered must be crossed out.

2.8.3 Revisions and Supplements

The completeness of the manuals shall be checked during installation, testing, commissioning and trial operation jointly by the Contractor and Engineer- in- charge.

If it becomes evident during the installation, commissioning trial operation and defects liability period of the Works that the Operation and Maintenance Manuals are inadequate or incorrect, the Contractor

shall supply immediately the necessary supplements and corrections. This shall be handled in the following manner:

- Deletions:

One sheet of errata, printed on pink paper, shall be issued indicating the pages and date of issue of those pages, which are to be deleted, and are no longer valid.

- Corrections, Revisions, Replacements:

New sheet or sheets shall be issued to replace the wrong pages. Whenever a new sheet is added to the instruction manuals, this sheet shall be given the new date of issue and a revision symbol, and an indication "Substituted for ... " and a marking of the corrected/revised items.

- Insertions, Supplements:

Insertions or supplements shall be accompanied by a new respective "Table of Contents" page, where the latter shall be handled as described above under replacements.

The revisions and supplements requested by the Engineer-in-charge shall be made by the Contractor at the Site as far as possible and shall be submitted in each case to the Engineer for checking and approval as stated above.

Before issuing the "Taking-Over Certificate", the ten sets of revised copies of the Operation and Maintenance Manuals shall be submitted together with the specified number of complete sets of drawings of the Works as completed. The Works shall not be considered complete for purposes of taking over under the terms of the General Conditions of the Contract until the above documents have been supplied by the Contractor.

2.9 PROGRESS REPORTS DURING DESIGN AND MANUFACTURING

During every quarter design and manufacturing the Contractor shall quarterly submit four (4) copies of the progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding period. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and include any notable problems, which were encountered.
- The total overall percentages of design and manufacturing works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- The percentages of each main work activity completed during the reported quarter vis-à-vis the scheduled programme. Appropriate comments shall explain any differences.
- A list of all activities of scheduled and actual progress during the reporting period including actual starting dates versus scheduled

starting dates and actual completion dates versus scheduled completion dates for each activity. Appropriate remarks shall explain any differences, and also methods/actions prepared to be taken for making up the deficiencies in actual design and manufacturing process.

- A list of activities scheduled to be started within the next two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.

2.10 PROGRESS REPORTS DURING INSTALLATION AT SITE

During erection the Contractor shall, before the tenth (10th) day of each calendar month, submit four (4) copies of the monthly progress reports in a format acceptable to the Engineer, detailing the progress of the work during the preceding month. The report shall contain (but not be limited to) the following information:

- A general description of the Works performed during the reporting period on each main activity, and includes any notable problems, which were encountered.
- The total overall percentages of erection works completed, with reference to the CPM programme. Appropriate comments shall explain any differences.
- The percentages of each main work activity completed during the reported month with reference to the scheduled programme. Appropriate comments shall explain any differences.
- A list of all activities of scheduled and actual progress during the reporting period including actual starting dates and scheduled starting dates and actual completion dates, scheduled completion dates for each activity. Appropriate remarks shall explain any differences.
- A list of activities scheduled to be started within the next period of two (2) months, with expected starting and completion dates. If the expected starting and/or completion dates are different from those shown on the CPM programme, an explanation shall be given.
- A list of local manpower (by trade classification) employed during the reporting period.
- A list of expatriate personnel (by position) employed during the reporting period.
- A list of the Contractor's Equipment and materials available at the Site at the beginning of the report period. Also a list of equipment and materials, which arrived at Port of entry and status of custom clearance.
- Photographs of progress of significant events. The Engineer-in-charge may demand specific photographs if deemed necessary.

- Main items of temporary facilities constructed during the reporting period.
- A statement detailing the status of progress on the overall programme and how to regain any lost time or setbacks, which may have occurred.
- A list of inoperable temporary equipment, and the estimated date when the repair will be completed.
- A statement about labour relations & an explanation of actual and potential problems.
- A listing of each accident at the site involving the hospitalization and/or death of any person
- A listing of the amount & date of any payments received during the reporting period & the amount of any monthly invoice, which has been submitted but not yet paid.
- A list of claims (if any) submitted during the reporting period including the claimed cost & extension of time.
- A statement concerning potential problems and recommendations on how they could be resolved.

3. SPARE PARTS AND TOOLS

3.1 SPARE PARTS

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Works supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components. Before issue of the Taking-Over Certificate the spare parts shall be checked at the Site by the Contractor in presence of the Engineer in charge/Employer.

Acceptance of any spare part will not take place before the Contractor has submitted the complete final detailed list of all spare parts and tools.

All spare parts shall be protected against corrosion and shall be marked with identification labels in English. The identification shall be in accordance with the agreed Works Identification System.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage.

3.1.1 General Spare Parts

At least the quantity of general spare parts specified below shall be included in the Total Tender Price and consequently in the scope of Works of the Contract.

If the same spare parts are listed twice under "General Spare Parts" as well as under “Spare Parts", the quantity listed under "Spare Parts"

shall take priority over the quantity stipulated under "General Spare Parts".

- Spare Parts subjected to Wear and Tear.

For each installed assembly such as Servomotors, Pumps, Motors, Main Inlet Valves, Pressure Oil Units, Gates, Valves, Compressors, Cranes, Machine Tools etc. the following general Spare Parts shall be delivered.

One (1) complete sets of:

- Facing rings of mechanical seals
- Protection sleeves
- Carbon brushes for motors (if applicable)
- Inserts of filters
- Bearing bushings
- Brake liners
- Pickings
- Roller bearing for rotating shafts and seals for rotating shafts
- Driving belts
- Wearing parts of couplings
- Frequently actuated springs
- Outdoor installed pressure hoses

Wear and tear items shall be defined as such, which require replacement several times during the service life of the assembly.

- Customary Spare Parts:

For a number of like and identical assemblies the following spare parts shall be delivered, whereas one set shall be defined as the total quantity for one assembly:

- "X" Complete Sets related to "Identical Assemblies":
- Seals, gaskets and packing
- Thermometer, manometer, flow meter, level indicator (with and without contacts)
- Transducer 4/20 mA for position, pressure, temperature, flow
- Indoor installed pressure hoses
- Lamps, signal lamps, push button and switches
- Fuses, clamps
- Limit switches, auxiliary relays, pressure switches
- Roller bearings, sleeves and bushings for movable parts including for spherical joints
- Ball bearings.

- Resistance thermometer without indicator
- Motor-starters, contacts for feeder switches
- Springs
- "X" Complete Valves and Gates:

Related to "Identical Installed Standard Valves and Gates" (manually, hydraulically or electrically driven) including Drive like

- Shut-off valves and cocks
- Globe valves, needle valves or butterfly valves
- Non-return valves
- Pressure relieve valves
- Pressure reducing valves
- All solenoid valves
- Safety valves
- Aeration and venting valves
- Float controlled valves

The quantity "X" which shall be furnished is a function of the number "N" of supplied "Assemblies" or "Valves and Gates" identical in type and size.

N < 3 X = 1

N < 10 X = 2

N > 10 X = N/10 + 1, rounded-up to the next higher whole number

The Contractor shall provide 5%, but at least two pieces of all bolts, screws, nuts, washers, spanner rings and cotters. The quantity may be taken from the surplus handed over to the Employer after completion of the installation as described under 5.2 "Bolts, Screws, Nuts, etc." of this Section.

For all items under this Contract the Contractor shall deliver 5 % of the quantity of painting material, but at least one litre, in new sealed containers, for later repair work other than the Contractor's.

Parts with a special size or properties, as listed below are excluded as General Spare Parts:

- Bolts, screws, nuts, washer, spanner rings and cotters with a nominal diameter of more than 80 mm
- Roller bearings, bearing shells, sleeves and bushings for movable parts including for spherical joints with an inner diameter of more than 200 mm
- All valves and gates with a nominal diameter of more than 600 mm
- Main seals for gates, valves, access doors and openings with a total length of more than 2.40 m in straight length or circumference.

3.1.2 Spare Parts

The required specified spare parts are listed separately in the Technical Specifications. The price for each listed special spare part shall be provided individually in the Billing Breakup; the total price shall be included in the Total Tender Price.

3.1.3 Recommended Spare Parts

If any additional spare parts are recommended by the Contractor, these shall be stated in quantity and description in the Technical Data Sheets for each item.

Orders for recommended spare parts shall be optional to purchase by the Employer for a period of five (5) years after the date of the completion of the project. However optional spare parts will not be considered in tender evaluation.

3.2 TOOLS AND APPLIANCES

The scope of work shall include all customary and special tools, as well as auxiliary devices including lifting devices, ropes, etc. necessary for total assembly and disassembly of all parts of the supplied Works. Furthermore, all accessories for maintenance shall be supplied and included in the Tender. The total price for tools and devices as required by this article shall be included in the Total Tender Price.

The tools, wrenches, etc. shall be unused. Customary tools for erection shall be of the forged and polished chrome-vanadium type. Use of special tools and devices for erection shall be allowed, but shall be approved by the Engineer in each case. Special tools and devices shall be provided with means for ready identification.

All lifting devices and wire ropes slings to be used at site shall be tested at works and test certificate shall be supplied to the Engineer.

Suitable hardwood or steel boards arranged for wall mounting as well as tool carts and/or toolboxes shall be included in the delivery. An itemised list and description of all provided tools, auxiliary devices, storage equipment, etc. shall be included in the Tender. Acceptance of any tool or device shall not take place before the Contractor has submitted the complete final detailed List of Tools and Appliances.

Ropes, slings etc. shall be handed over in new condition. The Employer shall be entitled to take over from the Contractor the entire erection tools, appliances, instruments at mutually agreed conditions.

Specials tools as per the availability at site shall be provided to the Contractor for dismantling of existing equipment at site. However, non-availability of said special tools at site shall not absolve the Contractor from the responsibility to carry out the services such as dismantling and erection by arranging for special tools on its own.

4. DESIGN AND MANUFACTURE

4.1 GENERAL

Design, manufacture and construction requirements shall generally be as described below besides complying with the specific requirements elaborated in particular technical specification

4.2 DESIGN AND CONSTRUCTION REQUIREMENTS

The following directions, information and technical requirements for layout, design and erection shall be observed as far as they are applicable to the Works to be offered. The technical requirements of the General Technical Specifications are valid for all parts of the Works except where they are modified by additional and/or special requirements, specified in the other Technical Specifications.

Whenever a Contractor deviates from these Specifications, he shall furnish the data called for in Section 3 and give a summary of and the reasons for all deviations in the "Deviations from Technical Specification''. Failure to accomplish this may cause the rejection of his Tender, especially when a major deviation is involved.

All changes in the design of any part of the Works, which may become necessary after signing the contract, have to be submitted in writing to the Engineer for approval, with substantiation and justification.

Additional cost can only be accepted, in case of a basic design change, required by the Engineer-in-charge after award of Contract.

The Works shall be designed, manufactured, arranged and installed to meet functional needs and to provide neat appearance. All parts of the Works shall be arranged to facilitate supervision, maintenance and operation. All control sequences shall be simple and rational.

The parts of the Works shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without involving large scale and time consuming complex dismantling of other parts of the Works. They shall be designed, and manufactured in accordance with the latest recognised rules of workmanship and modern engineering practice.

The regulations, standards and guidelines listed in these Specifications shall be observed in the design, calculation and manufacture of the Works.

All parts of the Works shall be suitable in every respect for continuous operation at maximum output under the climatic conditions and operating conditions prevailing at the Site.

Special attention shall be given to Works, parts of which are delivered by different manufacturers. Problems arising in this conjunction shall be solved by the Contractor and be defined in writing.

For individual items of the Works, materials and design are to be selected which are best suited for the most severe operating conditions

to which the parts in question will be subjected. Only such design and types of Works shall be offered which have proven reliability in long-term continuous operation.

All live, moving and rotating parts shall be adequately secured in order to avoid danger to the operating staff. All electrical components shall be electrically earthed.

Contractor shall take appropriate measures to prevent the ingress of dust into any Works (such as bearings, relays, control and measuring equipment, winding, oil tanks, etc.), which may be endangered thereby.

Suitable lifting eyes and backing-out bolts shall be provided where required or where they will be useful for erection and dismantling.

Pockets and depressions likely to hold water shall be avoided, and if not avoidable they shall be proper self draining arrangement.

Parts of the Works principally intended for standby purposes shall be protected from corrosion by careful choice of material and if necessary, by additional means; these should not reduce their continuous standby readiness.

All design details and layout matters shall be discussed in periodic meetings with the Engineer- in- charge. The first design meeting between the contractor and the Engineer – in - charge shall take place within 60 days after the date of signing of the contract or placement of the order. Further design meetings shall take place as agreed between the participants until the design work is completed.

4.3 ALLOWABLE STRESS

The design of the parts of items of Works shall fundamentally consider the most severe conditions to which they will be subjected during testing and operation.

If different stress values are given in the General/Particular Technical Specifications or in the relevant standards and regulations, then the most stringent values shall be applicable.

The dimensions of the parts which are exposed to repetitive and alternating stresses as well as to impacts and vibrations shall take into account the safety measures approved in practice.

4.4 DESIGN CRITERIA

The plant equipment shall be designed for the worst possible combination of the following loading conditions as applicable:

- All static and dynamic hydraulic loads,
- All loads due to dead weight and frictional forces,
- Seismic or wind loads, and
- Other loads

4.4.1 Deleted

4.4.2 Seismic Loads

The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account as per the seismic Zone-IV for the computations.

Stresses resulting after including these loads shall not exceed permissible stresses.

4.4.3 Wind Loads

The basic wind load as per IS 875 (Part - 3) shall be applied on the vertical projected area, multiplied with the applicable factor for the different type of structures.

4.5 TOLERANCES

Gates

Water leakage under any head and without the use of any additional sealing materials per m length of seal:

- For Intake gates 1.0 l /m/m

4.6 STANDARDIZATION OF WORKS

Every effort shall be made to standardise parts and minimise costs of the Works throughout the Works in order to facilitate keeping stocks, maintenance, replacement, interchangeability, etc.

The Engineer-in-charge, therefore, reserves the right to demand the different contractors to use uniform types or makes of works & materials. The contractor shall not be entitled to claim extra payment on this account. This shall especially be applicable to small mechanical and electrical works such as:

- Valves
- Thermometers
- Pressure gauges
- Flow meters
- Water level gauges
- Terminals & terminal racks
- Indicating instruments & meters
- Auxiliary relays
- Contactors, fuses
- Motor protection switches
- Control devices
- Lights, bulbs, plugs, sockets

- Limit switches
- Level switches

The types or makes to be used shall be decided later by the Engineer-in-charge. All instrument scales shall be written in the ruling language of the contract and in the international SI- System of units.

4.7 QUALITY OF MATERIALS AND WORKS

For general requirements concerning the quality of materials and Works, the applicable sections of the Technical Specifications, Section-14 may also be referred.

4.8 NOISE

The noise level caused by the installed Works shall not exceed the following values if not otherwise stated in the Technical Specifications:

- Machine hall, workshops, etc.- max. 85 dB (A) at any place 1 m distant from operating equipment.
- Offices, control rooms, first aid rooms, canteens, etc.- max 55 dB (A)
- Emergency diesel generators max. 85 dB (A) at 1 m distance, open field

The noise level definition and measurement shall be in accordance with relevant ISO and IEC. The values stated shall be adhered to taking a normal civil construction into account.

"Not withstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable“.

4.9 IDENTIFICATION PLATES

4.9.1 General

Each important part to be delivered under this Contract shall be equipped with permanent identification plates in readily visible locations. Whether a part shall be considered as important in this respect shall be decided by the Engineer.

The identification plates shall be protected during erection and especially during painting. Damaged or illegible identification plates shall be replaced by new ones. The identification plates of non-corroding, non-disintegrating material (except manufacturer's nameplates of small standardised components) shall be inscribed in the Contractual language.

The inscription shall be printed, stenciled, or hand-written, but in any case, waterproof, oil-proof and wear-resistant. Works (machines, transformers, etc.) nameplates shall be either of the enamelled type or be of stainless steel covered after stamping with a transparent paint.

Wording, size and material of all labels and plates shall be subject to the Engineer's approval.

4.9.2 Manufacturer's Nameplates

The following data shall be shown in accordance with the relevant standards:

- Manufacturer's name and address
- Work's serial number and date of manufacture
- Main design data.

As a general rule, standardised components, such as small or medium-sized electric motors, transformers, instruments, etc., may be delivered with the manufacturer's standard nameplate.

The design of the Manufacturer's nameplates for the main components such as gates, cranes, valves, hoists, servomotors, pumps etc., shall be submitted for the Engineer's approval sufficiently in advance.

4.9.3 Functional Plates

Each part appearing under a certain symbol or number in functional diagrams, piping diagrams, in the Operation and Maintenance Instructions, etc., shall be equipped with a plate showing the same symbol or number.

4.9.4 Instruction Plates

All plates showing designations or instructions for operation, safety, lubrication, etc. shall have a uniform design.

4.10 COLOUR CODE

4.10.1 Colour Coding For Electrical Connections

Live parts of electrical connections shall be Colour coded as follows:

Conductor Designation	Coding Alphanumeric	Symbol	Colour
A.C. Network 3 Phase	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
A.C. single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green-yellow
D.C. Network	Positive	a	Red
	Negative	b	Black

4.10.2 Colour Coding For Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc. shall be colour coded as follows:

132 kV	Gold
11 kV	Signal red
415 V	Black
220 V DC	Violet
48 V DC	White

Note: Colours mentioned above shall be finally agreed upon during detailed design .The colour code for equipment not listed in the above mentioned Specifications shall be agreed upon after award of the Contract. The colouring of pipelines, moving parts, etc., shall be according to internationally recognised standards

4.11 WORKMANSHIP

The Contractor shall level and adjust all parts of the equipment on the foundations and after each item is set up and the Engineer-in-charge approval obtained, grouting or concreting will be carried out by other contractors and verified by the Contractor. The Contractor shall be responsible for ensuring that such work is carried out to his satisfaction and that level and adjustments made by him are not disturbed by the grouting operation. The Contractor shall be responsible for ensuring that the positions, levels and dimensions of the Works are correct according to the drawings notwithstanding that he may have been assisted by the Engineer in setting out the said position, levels and dimensions.

4.11.1 Finished Surfaces

Where the finish is not indicated or specified, the type of finish shall be most suitable for the surface to which it applies and shall be consistent with the class of fit required.

Surfaces to be machine-finished shall be indicated on the shop drawings by symbols. Compliance with the specified surface shall be determined by the sense of feel and by visual inspection of the work compared to applicable "Standard Roughness Specimens", or with roughness feeler gauge instruments. Both "Standard Roughness Specimens" and feeler gauge instrument shall be procured by the Contractor at the request of the Engineer.

4.11.2 Unfinished Surfaces

As far as practicable, all works shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined to secure proper alignment.

Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and

rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in a manner approved by the Engineer.

4.11.3 Protection of Machined Surfaces

Machine-finished surfaces shall be thoroughly cleaned of foreign matter. Finished surfaces of large parts and other surfaces shall be protected with wooden pads or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

4.11.4 Rounding, Chamfers, Edges

The edges of surfaces to be painted shall be rounded (minimum radius 2 mm) or chamfered accordingly. This requirement must be stated in all shop drawings for the relevant parts.

4.12 WELDING AND HEAT TREATMENT

4.12.1 General

All welds shall be as shown in detailed drawings and shall be made in such a manner that residual shrinkage stresses will be reduced to a minimum.

The Contractor shall submit with his Tender adequate information concerning the proposed:

- Extent to which automatic welding techniques will be applied;
- Extent to which manual welding techniques will be applied;
- Extent to which he intends to use pre-weld heat treatment, post-weld stress relieving, full anneal stress relieving or normalising consistent with the thickness and types of material proposed;
- Weld electrodes, welding wire and flux, which will be used with the selected plate material or materials;
- Standard tolerances for the deviations of mating weld profiles.

4.12.2 Welding

Pieces to be joined by welding shall be cut accurately to size including the required allowances. According to the proposed welding method, the welding edges shall be sheared, flame-cut or machined to allow thorough penetration and fusion of the weld with the base material.

The cut surfaces shall be free of all visible defects, such as laminations, surface defects caused by shearing or flame-cutting operations. The edges and surfaces to be welded shall be free of rust, mill scale, grease, oil, paint or any other foreign matter. Welding over zinc primers shall be permitted subject to submission of a certificate of a recognised institution stating the pertinent limiting parameters for this welding procedure. In all other cases, welding over paint shall be

prohibited; all painting materials next to the joint to be welded shall be removed well beyond the heat-affected zone.

Unless otherwise allowed by the Engineer in charge, all steel parts to be welded shall be manufactured of steel produced by the open hearth or electric furnace with Carbon content not higher than 0.20 % and a phosphorous content of not more than 0.05 %.

Wherever welding is specified or permitted, a welding process approved by the Engineer-in-charge and conforming generally to DIN or other approved standards shall be used. Approval of the welding process shall not relieve the Contractor of his responsibility for correct welding, the use of correct electrodes and for minimizing distortion in the finished structure.

When the welding process has been approved by the Engineer in charge, the Contractor shall produce a record drawing to show the approved process. The drawing shall include details such as the form of edges to be welded, electrodes and other welding materials, welding sequence, etc. Changes in the welding process after the welding method has been approved shall require the consent of the Engineer in charge.

Where possible, welding shall be carried out in the workshop. Welding which has to be performed in the field shall be clearly so indicated on drawings.

The Contractor shall follow the steel manufacturer's recommendations concerning electrodes, welding and material pre- and post heat treatment. Notwithstanding the above, the suitability of the electrodes to be used for welding and the welding methods to be used for both shop and field welding shall be demonstrated by trials and tests to the satisfaction of the Engineer-in-charge.

Additional copies of all records of all welding procedures, including preheating and stress relieving, chemical analysis and physical properties, shall be made available to the Engineer upon request.

Design, preparation, performance and testing of welded constructions shall suit the kind of stresses and the grade of risk, considering a supposed failure of the welded member.

The following table shows a general classification by means of numbers with the significance of each number explained thereafter.

Any structure not especially mentioned shall be classified by the Contractor and shall be subject to approval by the Engineer-in-charge.

	STRESS		
	Compression	Bending	Alternating, Dynamic Tension>0.9 allowable stress
Small risk Stairs, Rails, doors	0	0	1
Medium risk Cranes,	4	4	7

trusses, bridges			
High risk Penstocks, steel linings, spiral distributor, nozzle, runner, gates, stop logs etc.	5,6,7,8	5,6,7,8	5,6,7,8

Significations

0= without special prescriptions. Only skilled welders shall be employed which follow proven rules of workmanship.

1= Full penetration welds. The weld preparation shall allow the filling of the weld profile without defects. The root of double welded butt joints shall be ground before welding the second side. If the second side is inaccessible for welding, such single welded butt joints shall be built up against a backing strip.

2= Weld ground flush. The weld shall be ground on both sides of the steel plate. The weld surface shall be finished so as not to reduce the plate thickness by more than 3%. Butt welds with a smooth surface and a chamber of less than 8% of the width of the top layer need not be ground.

3= Connections rounded. Where stresses are to be deviated, already the design shall care for a reduced notch effect. Welds shall be smoothly ground and rounded.

4= Welder qualification test. All welders and welding operators shall have passed qualification test in accordance with the respective National Standard or rules of AWS-American Welding Society, or the DIN EN 287.

5= Welding procedure test. The Contractor shall describe the proposed welding procedure. Further he shall prove with tests, that the properties of the weld and transition zone are at least equal to those specified for the base material.

The welding procedure test may be combined with the welder's qualification test.

6= Welding performance test, executed during fabrication and site welding. Run-off plates shall be tack-welded to one end of the plate under work. The weld shall continue on that run-off plate (test plate), welded in the same manner and under normal working conditions.

One test plate is required every 20 m of weld seam, but at least one of each weld type.

The laboratory tests shall cover the same range as the welding procedure tests.

On request by the Engineer test plates shall be welded in his presence.

7= Ultrasonic and/or radiographic test. Depending on the location of the weld seams and the plate thickness, ultrasonic and/or radiographic tests shall be performed. The Contractor shall submit a proposal subject to approval by the Engineer. If not stated differently in the Technical Specifications, 20% of the weld length shall be checked

through ultrasonic testing, but at least one film per weld type. The Contractor shall record the results of the ultrasonic and/or radiographic testing in these reports and drawings.

8= Marked with welder's stamp. The welder shall mark every seam welded by him with his number, so it can be recognized until the end of the fabrication period.

4.12.3 Welding Qualifications

For welding of principal stress carrying parts, the standard of welding procedures, welders and welding operators shall conform to standards equivalent to the requirements of the ASME Boiler and Pressure Vessel Code, Sections VIII and IX, or DIN 8560, DIN 8563, EN 287

For welding of less important parts, the standards and qualifications shall conform either to the AWS Standard Qualification Procedure or equivalent standards.

All welders and welding operators assigned to the work shall have passed a performance qualification test. If more than one year has elapsed since the welder or welding operator passed his last test, then he shall again be tested.

Welders' and welding operators' test certificates shall be submitted to the Engineer.

4.12.4 Welding Work

All welding (except welding of thin plates or piping of small sizes) shall be performed by the electric-arc method and where practical, with process controlled automatic machines.

The strength of welding of all equipment subject to high and /or alternating stresses, vibrations etc. shall be at least equal to the strength of the parts being weld-jointed.

Between plates and other sections where such stresses are to be transmitted only butt welds shall be permitted. All main butt welds shall have 100% penetration and where possible, shall be welded from both sides. The backside of the first run shall be suitably gauged out to clear metal before the sealing runs are deposited.

Butt welds on site, which can be welded from one side, only shall be provided with back strips on the whole length of the seam to be welded. The back strips shall be fixed to the downstream side of the upper element, to prevent accumulation of water and dirt.

For any welding work, only the appropriate welding rod, either arc or gas, shall be used. The properties shall conform to the material to be welded as specified in the respective standards.

The electrodes for arc welding shall be classified on the basis of mechanical properties of the as welded deposited weld-metal, type of covering, hydrogen absorption, welding position of the electrodes and type of current.

Electrodes shall be used only in the positions and under the conditions of intended use in accordance with instructions with each container. Electrodes for manual welding shall preferably be of the heavily coated-type and shall be suitable for welding in any position.

After being deposited, welds shall be cleaned of slag and shall show uniform sections, smoothness of weld metal, feather-edges without overlap, and no porosity and clinker. Visual inspection of the ends of welds shall indicate good fusion with the base metal.

Where weld metal is deposited in successive layers, each layer shall be thoroughly preened before the next layer is applied.

The difference in thickness of adjacent butt-welded plates shall not exceed 3 mm. where plates of greater thickness are to be welded; a transition with a gradient of 1:5 shall be formed.

Welds shall be balanced as far as possible to minimise distortion and residual stress. Box type girders shall be welded in such a way as to be completely airtight.

All welds transverse to the direction of flow and the longitudinal welds of distributors, shut-off valves and manifolds shall be ground flush with the plates on the inside. Welds shall be ground flush on both the inside and the outside wherever dynamic stress occurs.

Particular care shall be taken in aligning and separating the edges of the members to be joined by butt-welding so that complete penetration and fusion at the bottom of the joint will be ensured.

All pinholes, cracks and other defects shall be repaired by chipping or grinding the defects to sound metal and re-welding. Where fillet welds are used, the members shall fit closely and shall be held together during welding.

The ignition of weld electrodes shall not be started at the plate beside the weld, but at the seam flanks to prevent detrimental increments of local hardness. Where ignition points of electrodes are discovered, they shall be ground appropriately.

Where auxiliary structural members are welded to components for the purpose of assembly or installation, these connecting welds shall be given particular care.

These auxiliary structural members shall be removed not by knocking them off, but by burning, followed by grinding the affected areas flush with the plate, without producing additional thermal stresses.

4.12.5 Heat Treatment

The cost of any heat treatment prescribed by the manufacturer of the materials and the Contractor respectively for the welded parts to be supplied shall be included in the Contract Price.

Heat treatment of field erection welding seams shall be performed according to the specifications for the welding procedure for the

corresponding parts, which shall be submitted to the Engineer for approval.

4.12.6 Quality and Procedure Control

Quality control methods, e.g., radiography, ultrasonic crack detection, etc., shall be done in accordance with the appropriate codes. However, the Contractor shall indicate clearly in the Technical Data Sheets the extent to which these methods shall be used.

All welded joints, which have to be tight, shall be inspected or tested by dye penetration tests.

All major welds carried out on parts under hydraulic pressure shall be subjected to a minimum of 20 % radio-graphic testing and 100% ultrasonic testing. All welds on the skin-plates shall be tested additionally by dye penetration method as decided by the Engineer- in-charge.

The Contractor shall indicate in the corresponding drawings the type of non-destructive testing to be carried out during manufacture and at Site.

The following or other equivalent Standards shall apply:

- For radiographic examination:

  DIN 54109 Non-destructive Testing; Image Quality of Radio-graphs of Metallic Materials

  DIN 54111 Non-destructive Testing; Testing of Welds of Metallic Materials by X- or Gamma Rays; Radiographic Techniques

  DIN EN 287 Quality Assurance of Welded Structures; Fusion-welded Joints Steel; Requirements Classification

  AD-leaflet HP 5/3 Manufacture and Testing of Pressure Vessels

- For ultrasonic examination:

  According to the approved "Test and Examination Instructions" of the Contractor based on AD-leaflet HP 5/3.

  All radiographic films and data shall become the property of the Employer.

Additional non-destructive controls can be required when it is desired to examine the acceptability of any welds when, in the opinion of the Engineer, serious doubt exists as to their quality; in this case, the expense of this examination shall be borne by the Contractor.

When required in the Particular Technical Specifications, the detailed description of welding procedure (including type of welding electrodes, sequence of welding seams, etc.) for certain parts of the delivery shall be submitted to the Engineer before commencement of manufacture.

4.12.7 Defects and Repairs

Plates with laminations discovered after cutting shall be rejected unless the laminated portion is only local and can easily be repaired; such repairs shall require the consent of the Engineer.

Defects in welds will be reported to the Engineer. The Contractor shall use his discretion in determining whether or not it is advantageous to remove and repair the weld. His decision will require approval by the Engineer.

Defects in welds, which are to be repaired, shall be chipped out to sound metal and the areas magnifluxed or ultrasonically tested to ensure that the defective material has been completely removed before repair of welding is carried out. The Engineer shall be informed and given the opportunity of making an examination after the defect has been removed and before repair welding commences. Repairs shall be carried out in accordance with the relevant Standards and to the approval of the Engineer. The Contractor shall be fully responsible for the in-service performance of all welding work.

The Work shall be 100% inspected again by the method used first to determine such faulty work.

4.13 Corrosion Protection

4.13.1 Scope of Work

The Contractor's services shall cover the procurement of all materials, and the preparation and application of the painting and other protective coats as specified; all costs shall be included in the Tender Price.

4.13.2 Painting Materials

The Contractor shall provide a complete, reliable coating system. Coating materials shall be standard products of a paint manufacturer with proven experience in the field of corrosion protection of the type of works to be supplied.

The Contractor shall submit for the Engineer's approval full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the Works.

Paint material shall be delivered in unopened original containers bearing the manufacturer's brand name and colour designation, storage directions and handling instructions. The entire paint material for a particular specified paint system shall be supplied by one manufacturer only; who shall guarantee the compatibility and quality of the paint material. A complete list of the proposed paint material shall be submitted to the Engineer. For multicoated painting systems each coat shall have a different colour.

With regard to materials, the Contractor shall submit full details including the source of the basic raw materials, volatile matter content, nature of solvent, number of components, type of coat, coverage, time interval between coats and number of coats, compatibility of each coat with the previous coat, toxic properties, physical properties, shelf life, resistance against chemical attack, resistance against ozone and UV-radiation, compatibility with drinking water standards, etc.

It shall describe in detail the treatment he proposes to apply in order to give adequate protection during transport, site storage, building and concreting and subsequent erection.

The different coats of primer and subsequent coats shall be each of different shades of colour where practicable.

The Contractor shall submit to the Engineer-in-charge for approval an overall colour scheme in accordance with the Technical Specifications, for the finished surfaces of all Works. All final coats shall be in the colours approved by the Engineer. On request of the Engineer, painting samples for the different coats and colours shall be provided.

All pigment, paints and primers shall be delivered to Site in sealed containers packed by the manufacturer. The manufacturer's instructions for preparation and application of all painting and protective coats shall be strictly observed.

Paint materials shall be stored and mixed by the Contractor in strict accordance with the manufacturer's instructions. Paint material shall be used before the expiration of the shelf life. All safety regulations shall be observed, especially with regard to fire.

4.13.3 Painting Systems

Annex 1 "Painting system", indicates painting materials considered suitable for the various parts of the Works.

4.13.4 Workmanship

4.13.4.1 Contractor's Equipment

The Contractor shall observe all safety and health precautions to protect his workers and others. The necessary equipment, such as fans, air-conditioning units, safety masks, nets, safety belts etc. shall be provided by the Contractor. All equipment shall be in strict accordance with the respective safety codes and regulations assuring efficient work of high quality.

The Contractor shall be responsible for the collection and disposal of empty containers, dirty rags and other wastes. It shall also be the Contractor's entire responsibility to protect equipment and structures not being painted such as nameplates, instruments, panels, floors, walls, etc. and he shall provide and install all necessary drop cloths and screens.

4.13.4.2 Preparation of Paint Material

Paint shall be delivered ready mixed wherever possible. Adding of diluting agents and mixing of two or multi-component systems shall be done in the field in accordance with the directions of the manufacturer. Mixing and homogenising of the paint material shall be done by a mechanically driven paddle or agitator in the original container. After mixing, the paint shall be poured into a clean container to ensure that no settled pigments are at the bottom.

The Contractor's equipment shall be of perfect quality and servicing and maintenance must be guaranteed. Cleaning of equipment shall be consistently carried out at each working interval.

4.13.4.3 Application

The most commonly used methods of application are painting by brush, roller, pressure and airless spraying equipment. Selection of the application method depends on the surface to be painted. The quality of the paint shall in no way be negatively influenced. The manufacturer's directions shall govern the choice of application method. Inaccessible surfaces shall be painted prior to erection with prime and finish coats according the specification. Areas inaccessible to spraying equipment shall be painted by brush. Corners and edges shall be pre-coated. Bolts, screws, studs, rivets etc. shall be painted as a whole with the complete paint system after erection.

The primer shall be applied to an absolutely clean and dry surface only. Temperature and dry-out time shall be in accordance with the manufacturer's directions. Whenever possible the prime coat as well as one intermediate coat shall be applied in-doors at the Contractor's shop.

During painting the air temperature shall be at least +5°C and the temperature of the items being painted must be at least 3°C above the dew point. During drying of the paint, the temperature shall not be below 0°C. For all paints the surface temperature of the metal shall not be higher than +50°C during the painting. Concerning special paints, the requirements set by the paint manufacturer shall be followed.

Cleaning and painting work outdoors and in non-conditioned rooms shall be stopped under the following conditions: rain, fog, dew, polluting winds, sand and other dusts. The object to be painted shall be removed to safe places or indoor suitably protected with cover etc. Surface preparation and application of the first paint layer are parallel operations to be carried out within a maximum delay of 4 hours.

All painting shall be free of cracks and blisters and all runs shall be brushed out immediately. After application of the last coat the paint system shall be free of pores. After erection of the equipment all damages to painted surfaces shall be repaired. Welds, rusty spots, slag, beads, flux deposits etc. shall be repaired and repainted. For touching up, the same materials shall be used as for the main painting

work. Repaired finish coats shall be of the same appearance as the original coating.

Electrical plates, surface hardware, fittings and fastenings shall be removed before starting painting operations and shall be stored, cleaned, and reinstalled after completion of work.

Equipment requiring special knowledge, skills and tools shall be prepared to receive field coating and painting to meet requirements of the painting schedule.

Parts, which are embedded in concrete, need not be protected against corrosion. However, transition zones of large steel pipes and of steel linings shall be painted over a length of 1 m within the concrete, all other concreted in steel surfaces over a length of 200 mm within the concrete.

In linings surrounded by concrete, surface preparation and painting works shall be carried out after all Works such as concreting, welding, grouting and cleaning have been completed. The Contractor shall take into account the local climatic conditions and use adequate installations for sandblasting, dust control and sand extraction.

A properly equipped paint shop shall be set up at the Site with a crew of specialists experienced and skilled in the preparation and application of protective coatings, to deal with all site-protective treatment.

4.13.5 Surface Preparation

The term "preparation" as used below includes any cleaning, smoothing or similar operations that shall be required to ensure that the material to be painted attains a suitable condition.

To be ready for painting, a surface should be clean, dry and sound. The surface to be coated shall be free from any deleterious material liable to impair good paint adhesion or attack the coat.

For removing rust and mill scale on structural steel, piping and other steel surfaces, those parts suitable for sandblasting shall be sandblasted to a grade specified or required in accordance with SIS 05.59.00 (Sveriges Standardise rings Kommission) or the American Standard SSPC-SP. This applies particularly to parts, which will be in contact with water, exposed to heavy condensation and humidity or subjected to high temperature.

For health reasons, sandblasting with quartz sand shall be avoided.

Sand blasting shall be such as to obtain a smooth surface free of foreign matters with a roughness of min. 0.04 mm. Corundum or an equivalent mineral shall be used and the grain size of the blasting medium shall not exceed 1.2 mm.

All parts of the Works shall be sandblasted at the shop unless otherwise specified or approved by the Engineer. The sandblasted surfaces shall receive a shop coat with a quick-drying highly pigmented 2-pack zinc-rich primer, unless otherwise specified.

Parts, which cannot be sandblasted, shall be cleaned of rust by power tool cleaning to the highest degree possible.

Hand or power tool cleaned parts of minor importance and not exposed to water or humidity may be coated with a quick-drying rustproof primer formulated on a combination of synthetic resins (ready-mixed paint).

4.13.6 Quality Control

The minimum dry-film thickness prescribed in these Specifications shall be observed. Of each 100 m^2, one area of 10 m^2 will be measured for dry-film thickness. No measured thickness shall be less than the specified thickness. Where the minimum thickness is not achieved, the coat shall be repaired to reach the specified minimum dry-film thickness.

The dry-film thickness shall be measured by approved gauges; the cost of two new electronic gauges shall be included in the Tender for use of the Engineer in charge.

For checks on porosity, the Contractor shall furnish a D.C. variable high-tension test instrument with built-in pore counter. The test voltage shall not exceed 2000 V. The tests shall not be performed within 0.5 m distance from uncovered, corrosion resistance surfaces.

The instruments purchased for quality control shall be handed over to the Employer after commissioning of the Project without any payment to the Contractor.

Upon completion of each coat, the painter shall make a detailed inspection of the painting finish and shall remove from adjoining work all spattering of paint material. He shall make good all damage that can be caused by such cleaning operations.

A detailed inspection of all painting work shall likewise be made, and all abraded, stained, or otherwise disfigured portions shall be touched up satisfactorily or refinished as required to produce a first-class job throughout and to leave the entire work in a clean and acceptable condition.

4.13.7 Guarantee

The guarantee period for all painting shall be 24 months, starting from the issue of the "Taking-Over Certificate". This painting guarantee period shall be effective regardless of any other guarantee periods for the project or parts of the project issued prior to the elapse of the painting guarantee period.

At the end of the painting guarantee period the anti-corrosive protection of the painted or galvanised surfaces shall not have a degree of rusting higher than RE 1 (one) on the European scale of degree of rusting for anti-corrosive paints, (the corrosion committee of the Royal Swedish Academy of Engineering Sciences, Stockholm).

4.13.8 Priming

4.13.8.1 Surface Preparation

Blast cleaning can be undertaken with only when the following time and relative humidity schedule for application of the first coat can be achieved and maintained:

RELATIVE HUMIDITY	Time
85% or above	Do Not Blast
80-84	2 Hours
70-79	4 Hours
60-69	10 Hours
50-59	12 Hours
30-49	24 Hours
Under 30%	1 Week

4.13.8.2 Primer

The primer serves, in the first place, as protection against corrosion. In addition, adherence between base, primer and finish paint is achieved. Primers have only a limited weather resistance. The specified dry film thickness shall be applied to all surfaces of the equipment as required. After the aforesaid has been done, the equipment or parts thereof may be stored in the open air for a limited time only until the finish coat is applied. Only 2-component epoxy resin zinc rich primer shall be used for priming on sandblasted surfaces.

4.13.8.3 Galvanizing

Unless otherwise specified, all structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electrolytic galvanised or serialised, as may be appropriate to the particular case.

Galvanising shall be performed in accordance with VDE Standard 0210 (Verband Deutscher Elektrotechniker) or IS 4795:1996.

Material:

For galvanising, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

- For bolts and nuts, approx. 60 micrometer
- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 70 micrometer

- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 140 micrometer, in accordance with "VDEW, Druckrohrleitungen -Association of German Electricity Utility Companies, Steel Penstocks".

Cleaning:

All material to be galvanised shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.

Galvanising of plates and shapes:

Where pieces are of such lengths that they cannot be dipped in one operation, great care shall be exercised to prevent warping.

Finished compression members of steel structures shall not have lateral variations greater than one-thousandth of the axial length between the points, which are to be supported laterally. Finished tension members shall not have lateral variations exceeding 3 mm for each 1.50 m of length. Materials with sharp kinks or bends shall be rejected. All holes in material shall be free of excess spelter after galvanising.

Galvanising of hardware:

Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards. Excess spelter shall be removed by centrifugal spinning.

Straightening after galvanising:

All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

Repair of galvanising:

Material on which galvanising has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanising repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions.

Soldering shall be done with a soldering iron using 50/50% solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanised coating becomes damaged after having been dipped twice shall be rejected.

4.13.8.4 Items which are not to be painted

These items shall be given a protective coating of e.g. Tectyl 506 or another adequate material before leaving the Contractor's workshop. This protective coating shall be removed and the surface cleaned before erection.

4.13.9 Painting

4.13.9.1 Surface Preparation (Primed, Galvanised or Stainless Steel Surfaces)

All surfaces to be painted shall be thoroughly cleaned by suitable means before application of paint. After cleaning the surfaces shall be rinsed in a manner that no residues will remain.

Primed surfaces contaminated with oil or grease shall be de-greased in a manner not affecting the quality of the primer. 2-component coatings older than six (6) months shall be roughened prior to the application of the next coat.

Hot-dip galvanised surfaces, which are to be painted, shall be lightly sandblasted prior to through cleaning.

4.13.9.2 Finishing Coats

Whenever specific colouring is required or where priming is not sufficient for protection against corrosion a finishing coat shall be applied. If not otherwise specified, finishing coats shall be applied to primed surfaces. The primed surface shall be prepared as specified above. Selection of finishing coats with regard to quality and quantity shall be governed by the ambient conditions and its effect on the painted surface.

The Engineer-in-charge will select the type and shade of colouring in accordance with a standard colour code (e.g. VSLF, RAL, Munsell etc.). For this purpose the Contractor shall submit colour cards or colour samples. On request of the Engineer colour samples shall be applied to selected surfaces to be painted.

4.13.9.3 Painting Systems

The specified painting systems including surface preparation and the permissible application methods are listed on the enclosed charts (Painting Systems) Annex 1.

4.13.9.4 Cutting and Welding of Painted Structures

All painted structures to be cut by torch or blade for fitting and welding purposes and all field-welds shall be prepared.

Reason for this preparation work is the development of aggressive residue when the paint is burned. This residue cannot be removed and thus a proper surface preparation is not warranted.

Repair of the damaged surface protection shall be executed according to "Repair of Primer and Finish Coats" described below.

4.13.9.5 Repair of Primer and Finish Coats

General

For touching up, the same paint shall be used as for the original painting work. Repaired finish coats shall be of identical appearance with the original and no difference in the colour shall occur.

Galvanised and Painted Structures

Repairs on galvanised and painted structures shall be carried out as follows:

- Damages to painting and galvanisation:

Surface Preparation: Scraping, wire brushing or grinding to Grade ST 3 according to SIS 055 900-1967.

Repair of Coatings: One coat of 2-component epoxy resin zinc-chromate primer. Dry film thickness minimum 0.050 mm.

Two coats of 2-component epoxy-resin micaceous iron oxide (mio) paint. Total film thickness min. 0.160 mm.

The colour of the paint shall be the same as originally applied.

- Damage to Painting only:

Surface Preparation: Thorough cleaning of the damaged surface i.e. removal of oil, grease, dust, etc.

Repair of Coatings: Two coats of 2-component epoxy-resin micaceous iron oxide (mio) paint. Total film thickness min. 0.160 mm. The colour of the paint shall be the same as originally applied.

Painted Structures

Repairs on painted structures shall be carried out as follows:

Surface Preparation: Scraping, wire brushing or grinding to Grade ST 3 according to SIS 055 900-1967.

Prime Coat: One coat of 2-component epoxy resin zinc-chromate primer. Dry film thickness minimum 0.050 mm.

Intermediate and finish Coats: Type, number of coats and dry film thickness, shall correspond to the specified "Painting System" in Annexure- 1

4.14 METAL WORK

4.14.1 Embedded Metal Work

Unless otherwise specified, any foundations, wall & roof openings & coverings, concrete floor filling, sleeves in foundations & walls & trenches with floor plates for cables, will be provided by the contractor.

The contractor shall supply & install all anchors, fasteners, embedded metal work, piping, & sleeves associated with & required for the equipment to be installed under this contract, except if otherwise mentioned in the specifications.

As far as practicable, the supports shall be of good design throughout and preferably of an approved type.

Attachments to concrete shall wherever practicable be by means of embedded inserts of an approved proprietary type.

The Contractor will be responsible for the determination and details of all loads and forces exerted by his equipment and transferred to the foundation.

The Contractor shall show the location and full details of all embedded components on his drawings and shall be responsible for the completeness and accuracy of his drawings and the information supplied to others.

Any steel work which is to be built into the concrete foundations shall not be painted or coated unless otherwise approved or specified.

4.14.2 Miscellaneous Metalwork

Except where otherwise indicated elsewhere in the Particular Technical Specifications, the Contractor shall supply the following:

- All platforms, ladders, guards and handrails necessary for easy and safe access to Works, shall be supplied under the Contract. Handrails shall be of tubular steel construction except that the top rail shall be of flat bar, fitted with a formed plastic covering.

The use of ladders shall be kept to a practicable minimum. Where ladders are approved for use they shall be of steel, have an inclination of 70° to the horizontal and a minimum width of 450 mm.

- Safety guards at each point where normal access provision would permit personnel to come within reach of any moving equipment to be provided under the Contract.

All covers for pipe and cable trenches, required for completing the floors around and over Works supplied under the Contract will be supplied and installed. Unless otherwise approved, floor plates shall be of an angular pattern.

Covers and curbing for dismantling hatches in main floors will be provided by the contractor of civil works.

5. MECHANICAL WORKS AND STEEL STRUCTURES

5.1 GENERAL

All mechanical Works and steel structures of any mechanical or electrical installation shall comply with this General Technical Specification and the requirements of the Technical Specification.

The Works shall be of an approved, reliable design providing the highest possible degree of uniformity and interchangeability.

The design and arrangement of Works and installations shall facilitate erection, testing, operation and maintenance with utmost ease.

All Works shall be pre-assembled in the manufacturer's premises to maximum extent.

Revolving parts shall be so balanced both statically and dynamically that when running at normal speed and at any load up to the maximum, there will be no vibration due to unbalance.

Unless otherwise stipulated in other sections, all materials subjects to hydraulic pressure shall have an impact strength (Charpy V-notch) of not less than 35 J/cm^2 (at 0°C) whereby this figure shall be the minimum of each of 3 specimens. For steel plates this figure shall be understood for the transverse direction.

Where ever IEC specifications are mentioned in the tender specifications, equivalent Indian standards (IS) shall also be applicable/ may also be acceptable.

5.2 BOLTS, SCREWS, NUTS, ETC.

All bolts, studs, screws, nuts, and washers shall be to the ISO metric system except other standards will be considered for specific applications. The extent to which other standards are proposed shall be indicated by the Contractor. Bolts and nuts shall be hexagonal or socket headed. Sizes smaller than 4 mm shall be used only for instrument and relay internal connections.

Where mild steel bolts and nuts are used, they shall be of the precision cold forged washer faced type if commercially available in the size required. Alternatively, approved hot forged bolts and nuts, machined so that the undersides of bolt head and nut are faced and parallel to one another when assembled, may be used. In the latter case, a suitable fillet shall be machined between the bolt head and shank. All parts, other than structural steel work, bolted together, shall be spot faced on the back to ensure that nuts and bolt heads bed down satisfactorily. Bolts machined from bar stock shall not be used without approval of the Engineer in charge. All bolting material shall be adequately treated against corrosion before dispatch from the workshop. Mild steel nuts and bolts shall be zinc or cadmium plated. Stainless steel bolts, nuts washers and screws shall be used in water or when exposed to high humidity, for holding renewable parts and parts made of stainless steel.

All bolts or studs which will be subject to high stress and/or temperature shall be of approved high tensile material with nuts of approved material. All bolts and studs larger than 60 mm in diameter, which are not accessible for tightening, and un-tightening by commercially available pneumatic impact wrenches shall be drilled for heaters or shall have an extension for pre-tensioning by hydraulic tools.

Washers shall be provided under bolt heads and nuts unless otherwise approved by the Engineer. All ferrous nuts and bolts on Works items where dismantling may be required during the life of the Works shall have their threads coated with an approved anti-seize compound. When in position, all bolts or studs shall project through the

corresponding nuts by at least one thread, but this projection shall not exceed three threads, unless more length is required for adjustment. All nuts and set screws shall be securely fastened, to prevent loosening due to vibrations, using spring washers, lock nuts, split pins, self-locking inserts or 'Loctite' as appropriate for the purpose and material used.

The Contractor shall supply the net quantities plus 5 percent of all permanent bolts, screws and other similar items and materials required for installation at the Site. Any such rivets, bolts, screws, etc., which are surplus after the installation of the Works has been completed shall become spare parts and shall be wrapped, marked and handed over to the Employer.

5.3 SEALS

The material for large gate seals shall be of first quality non-ageing rubber material, which shall be unaffected by wetting and drying or temperature changes. The degree of hardness according to Shore shall be 50-55 for sill sealing and 60-80 for lateral sealing. In case the Contractor intends to supply synthetic rubber material, with or without fluro-carbon cladding, he shall furnish the name of the manufacturer and technical data of the material for the Engineer-in-charge approval.

Rubber Seals

Seals shall be designed and mounted in such a manner that they are adjustable, water tight and shall be readily removed and replaced.

Seals shall be moulded. Extruded seals will not be permitted. Where seals are installed curved, they shall be clamped in a jig, which shall form them to the proper radius before the holes are laid out and drilled, and the ends trimmed. Holes in related parts of the seal assemblies shall be carefully drilled, using a template, and assure proper matching when the seal units are assembled. Arrangements shall be made to provide effective continuity of sealing at the corners.

All adjusting screws and bolts for securing the seals and seal assembly in place shall be of stainless steel.

Seals shall be made of synthetic rubber suitable for the temperature ranges of equipment and conditions at the Site and shall be of a material that has proven successful in similar applications. Joints shall be watertight and seal materials shall have following physical properties as determined by tests made in accordance with the relevant Standards.

Property	Limits
Tensile strength	21.0 MPa minimum
Ultimate elongation	450% minimum
Durometer hardness (Shore, Type A)	60 - 70
Specific gravity	1.1 to 1.3
Water absorption (70°C for 48 hours)	5% by weight (max.)

Compression set	30% maximum
Tensile strength after oxygen bomb ageing (48 hours at 70°C)	80% (min.) of tensile strength before ageing

5.4 DRIVES AND GEARS

All moving parts of machinery including shafts, couplings, collars, projecting key heads, gear wheels, rope/ belt-drives shall be completely guarded to provide full protection. All setscrews on revolving shafts shall be countersunk or suitably protected. The guards shall be of approved design and shall be fitted, where necessary, with inspection doors/openings. All guards shall be arranged so that they can be removed without disturbing the parts of the gears and works, which they protect.

Gears shall be designed so that all stresses are within allowable limits when the maximum loads are being handled. All gears shall be designed and calculated in accordance with DIN, or equivalent international standards, or widely approved methods and to the individual experience of the manufacturer. On request of the Engineer in charge, the manufacturer shall submit the calculation of the gears.

Where worm gears are used as a direct drive, they shall have the same load and time rating as the motors driving them. The gears shall work in oil and the temperature rise of the oil bath shall not exceed 40-50 degrees C under normal working conditions at Site. The materials of the mating faces of worm wheel and worm shall be of a bronze/steel alloy.

Where practicable gear wheels shall be forced fit on the shaft and in addition, shall be keyed adequately to prevent any relative motion between the wheel and shaft. Where gears and couplings are secured in position by means of keys, they shall be easily accessible for tightening or removal. All keyways shall be machine cut. Couplings and collars shall be the shrouded or protected-type, free from projections of any kind.

All bearings shall be mounted in dust-proof housings. Base of bearing supports shall be machined, and shall rest on machined-surfaces.

5.5 LUBRICATION, LUBRICANTS, FUEL

Efficient means of lubrication, suitable for use under Site conditions, shall be provided for all moving parts.

The contamination of the air, water and soil by lubricants and fuel shall by all means be avoided by applying of an appropriate design and layout of the Works in conformity with the latest recognised standards for modern engineering practice.

The number of different lubricants, transformer oils, oils for pressure systems, etc., used in the items of Works throughout the Works shall

be limited to a minimum in order to facilitate keeping stocks and maintenance.

The Employer reserves the right to request the use of certain types of lubricants, oils, etc. The Contractor shall not be entitled to claim extra payment for this request. All different types of oils, lubricants, etc., shall be subject to the written approval of the Engineer.

Unless otherwise stated in the Particular Technical Specifications, the first filling of oil or grease for bearings, pressure oil systems, transformers, etc., including the necessary quantity for flushing and for the first oil change shall be included in the Tender Price.

5.6 PIPING, FITTINGS, VALVES, GATES AND HEAT EXCHANGERS

5.6.1 General

Unless otherwise stated, all piping shall be designed for a "nominal pressure". All piping shall be tested at 1.5 times the design/nominal pressure. All required piping shall be furnished complete with flanges, joints, expansion joints, gaskets, packing, valves, drains, vents, pipe suspensions, supports, etc.

Steel structures, walkways, platforms, stairs and ladders shall be provided to cross pipes with diameters of 600 mm and larger.

Welding as well as application of corrosion protection coats shall be done in the manufacturer's shop as far as possible.

Flanged connections or joints shall be provided only as required for transport, installation or for reasons of dismantling for repair.

Metric (DIN)-flanges shall be used throughout. Welded flanges shall be weld-neck or slip-on flanges. The raised face shall be machined.

Joints between stainless and normal steel flanges shall be of the insulated type.

If the piping crosses over joints of civil structures of different settlement, the piping shall be provided with flexible joints to allow for vertical, horizontal, and angular deviations.

Piping installation shall be sloped to prevent trapping of air bubbles. Where required suitable venting system shall be provided.

Adequate clearance shall be given to parallel pipes to allow for easy maintenance without disturbing other lines. All overhead piping shall have a minimum clearance of 2.00 m from operating floors and platforms.

Where required water piping shall be provided with anti-condensation insulation.

5.6.2 Piping, Fittings

Steel pipes of a diameter <100 mm shall be of carbon Steel. Steel pipes larger than 100 mm in diameter shall be made of galvanised carbon steel. Pipe connections embedded in concrete shall be welded. Other pipe connections shall be flanged. The flange material shall be in conformance with the pipe material. The Contractor shall select the location of the weldments as to ensure sufficient access for adequate touch-up treatment for corrosion protection.

Ductile iron pipes shall conform to ISO R 2531; class K9, fittings to class K12. Unless waived by the Engineer-in-charge, D.I. pipes and fittings shall be mortar lined to AWWA C 104, double thickness.

Stress calculations of steel pipes shall be in accordance with DIN 2413, "Steel Pipes under Internal Pressure" or with "AD-Merkblätter; German Association of Manufacturers of Pressure Vessels, Memos" or ASME equivalent. In no case, the superimposed stress of bending, tension, compression, etc., calculated to the shape variation hypothesis, shall exceed 0.7 of the yield point at maximum applied load at any point of the piping.

The maximum applied load shall take into account test pressure, water hammer pressure waves, thermal forces, dead weight, etc. On request of the Engineer-in-charge, a calculation on pipe stresses has to be submitted by the Contractor at no extra cost. The requested calculation will be subject to approval of the Engineer-in-charge.

The minimum steel pipe wall thickness shall be the "normal" or "standard" wall thickness as stated in the applicable standards.

Bends shall preferably be of the forged type. Mitered bends shall be allowed for larger sizes subject to the Engineer's approval. For smaller fittings ductile iron will be permitted, too.

5.6.3 Valves, Gates

Small valves and gates shall conform to DIN 3230, "Conditions and Terms for Delivery of Valves."

Generally, valves shall be leak-proof in either flow direction (except for non-return valves) when the nominal pressure is applied.

All valves with design pressures higher than PN 10 and diameters larger than DN 100 shall be workshop-tested to DIN 3230 for tightness and soundness of materials.

The change of the disc seals of butterfly valves shall be possible without dismantling of disc and body.

Valves shall close clockwise and be provided with position indicators. The drive units of motor-driven valves shall also be provided with hand wheels for manual operation. The hand wheel shall be operable under all conditions and shall be independent of the motor drive. Further, it shall not be rigidly coupled to the motor drive and shall not compulsorily turn when the motor is energised.

To facilitate operation, large valves and gates shall be provided with by-pass lines for pressure balancing, if required.

All valves shall be readily accessible for both operation and maintenance, and where necessary for ease of operation the spindles shall be extended and an approved form of pedestal hand-wheel provided at convenient operating floor level.

Shut-off valves shall be suitable for opening and closing against full unbalanced pressure, including closure against free discharge. If necessary, bypasses are to be provided to meet these requirements.

Valves spindles and pins shall be of stainless steel, nuts and bushes of bronze, and the body of Cast Steel.

All pressure reduction valves; safety valves and similar components shall be workshop-tested and provided with a work certificate 2.3 to DIN 50049.

5.6.4 Oil Piping

Piping of a diameter < 50 mm shall be of non-corrosive material. Pipes larger than 50 mm in diameter shall be seamless .Oil pipes shall be as far as possible be prefabricated in the manufacturer's works. They shall be welded except at terminal points and as necessary for erection and future dismantling. The Contractor shall select the location of the weldments so as to ensure sufficient access for adequate touch-up treatment for corrosion protection. Pipe connections larger than 50 mm in diameter shall be provided with steel-flanged connections.

All piping shall be hydrostatically tested at a pressure 100 % greater than the maximum working pressure. The entire pipe arrangement shall be subjected to the pressure test after complete assembly at the site.

Oil pipes shall not be embedded in concrete. Oil pipes crossing civil structures shall be routed through sleeves embedded in the concrete.

All oil piping shall be acid-treated to guarantee clean surfaces, completely free from welding residues.

This treatment shall be applied to workshop and site manufactured piping respectively.

The piping can either be treated in an acid-bath or be completely filled with acid. The duration of the treatment shall be approx. 6 hours. After that the piping shall be neutralised, flushed and corrosion protected for final installation.

5.6.5 Pipe Supports and Hangers

All pipe work and accessories shall be mounted and supported in a safe and neat manner.

All brackets, stays, frames, hangers and supports for carrying and staying the pipes, including their fasteners shall be included in the supply and completed by the Contractor at the Site. Pipes and fittings

shall be supported at or near flanges wherever feasible from the view point of handling.

Supports and hangers shall be designed and arranged so that any pipe can be withdrawn without disturbing the others.

All heavy valves and other mountings shall be supported independently of the pipes to which they connect, to the satisfaction of the Engineer-in-charge.

The Contractor shall supply drawings showing the location of each major anchor and support and the weight to be carried by that support.

5.6.6 Heat Exchangers

Unless otherwise stated, all the heat exchangers shall be designed for a nominal pressure PN 10. All piping shall be tested with 1.5 times the design/ nominal pressure. Specification of the material of the heat exchanger shall be:

- Cooling tube — Cupro-nickel having chemical Composition of **90:10**
- Thickness of cooling tube — 1mm or more
- Frame/body — Mild/cast steel

5.7 MECHANICAL INSTRUMENTS

All mechanical parts of instruments shall be suitably protected against shocks and vibrations, heat, humidity and splash water, etc.

Pressures gauges shall be provided with a damping liquid, e.g., glycerin, to compensate vibrations. Pressure gauges without damping means are not permitted, unless approved by the Engineer-in-charge.

5.8 PRESSURE OIL SYSTEMS

Pressure tanks shall be designed, fabricated and tested in accordance with approved standards. The appropriate inspection certificates shall be furnished. If the pressure is held by compressed air, then the requirements outlined in "Compressed Air Systems" of these General Technical Specifications shall also be applicable.

Oil sump tanks shall be provided with:

- Suitable access openings
- Fine mesh strainer combined with a magnetic filter through which all oil returning from the servomotors shall pass. The strainer shall be readily removable for cleaning.
- Dehumidifying air filter
- Flush-mounted oil-level indicator
- Filling connection with a suitable strainer
- Drain connection with hand operated shut-off valve.

Sump tanks shall be installed so that the bottom of the tank and the drain connection are at least 40 cm above the floor. The bottom of the tank shall be inclined in the direction of the drainage. The pumps shall be removable without the necessity of emptying the tank.

Servomotors shall be provided with suitable connections for pressure gauges on the pressure and suction sides of the piston. Servomotor piston rods shall be of stainless steel provided with a hard chromium layer of approximately 0.04 mm thickness. A suitable protection for the piston rod seal shall be provided.

5.9 COMPRESSED AIR SYSTEMS

The provisions for safety of the entire compressed air system shall conform to internationally accepted standards. The standards proposed by the Contractor will in any case be subject to approval of the Engineer-in-charge.

Vessels shall be of the cylindrical, vertical type and shall be mounted on a structural steel base. The inner surfaces of the vessels shall be protected with an appropriate paint coating or the vessels shall be hot dip galvanized. Each vessel shall be equipped with the following devices:

- 2 inlet sockets with valves
- 2 outlet sockets with valves
- 2 pressure safety valves
- 2 dial pressure gauges, one of the gauges with 4 electrical contacts
- 1 manhole or inspection hole
- 1 drain valve.
- In case the pressure vessel is used for pressurized oil or water systems, the vessel shall further be equipped with:
- 1 transparent level gauge with shut-off valves at both ends
- Level indicators with electrical contacts in number as required or specified.
- Compressors shall be provided with:
- Automatic lubrication
- Air-intake filter and silencer
- Thermometer for measuring temperature of the compressed air
- Automatic shut-down if the discharge air temperature exceeds a predetermined, adjustable value
- Discharging valves
- Water drain valves
- Water/oil separator
- Pressure safety valve

- Compressed air cooler
- Non-return valve
- Inlet pressure valve
- Outlet pressure valve
- Automatic moisture trap

The water / oil separator shall be equipped with an automatic solenoid-operated drain valve to achieve automatic draining during standstill. The compressor stages shall be equipped with discharge valves, which shall close time delayed after start to avoid compressor start against full pressure.

The compressors shall be delivered as package units on common frame with the appropriately sized AC squirrel cage motor and the respective motor starter panels, ready for operation.

Each vessel shall pass a pressure test at 1.5 x maximum working pressure for 8 hours in the manufacturer's workshop before coating is applied.

If requested by the Engineer-in-charge, each compressor shall pass a performance test in the manufacturer's workshop to a standard mutually agreed upon, e.g., DIN 1945, VDMA 4362, without extra cost. The readily assembled compressors, controls, and switchgear shall be subjected to functional tests.

Each vessel shall be furnished with a test certificate of an independent, reputable underwriters' society.

5.10 PUMPS

Non- submersible pumps & motors

Non-submersible pumps and motors shall be mounted on common frames.

Materials of the pumps shall be:

- Casing Cast steel
- Impeller stainless steel
- Shaft stainless steel
- Sleeves stainless steel
- Wear rings bronze
- Keys stainless steel

The pumps shall withstand corrosion and wear by abrasive matters within reasonable limits.

Shafts sealed by packing glands shall be fitted with sleeves. Seals shall be exchangeable without extensive disassembly of the pump. Leakage water shall be directed to suitable drainage facilities.

Each pump shall be fitted with:

- Check valve at the discharge side
- Air and drain valve
- Pressure gauge.

The size of the pump motor shall be 15 % higher than the maximum power required by the pump at any operation point

Submersible pumps & motors

For submersible pumps, pump and motor shall be contained in the same casing and designed as a package unit with incorporated suction strainer and check-valve.

The impeller shall be of stainless steel and the material for the other parts as specified for the non-submersible pumps above. For dirty water pumps, the water passages of corrosive material shall be rubber-lined.

The motors of submersible pumps operating in potable water shall not be filled with oil or other media detrimental to potable water. Motors of submersible pumps operating in dirty water may be filled with oil.

Dirty water submersible sump pumps with the motors mounted on top of the pump shall be suitable for running dry continuously, without damage to seals, bearings, or motors.

For all other items, the requirements described for non-submersible pumps shall apply.

For any pump, the overall pump-motor efficiency for the specified rated head and discharge shall not be less than 60%.

If requested by the Engineer-in-charge for pumps of a capacity higher than 30 kW, one in three pumps shall pass a performance test to DIN 1944, class II, with measurements taken at 0%, 50%, 80%, 100%, and 120% of specified discharge at rated speed. The results have to be certified in a workshop certificate 2.3 to DIN 50049. For pumps of a capacity higher than 100 kW, the shop tests shall be compulsory; test certificate 3.1 B in accordance with DIN 50049.

Prior to the test, the manufacturer shall provide certified motor performance curves.

5.11 LIFTING EQUIPMENT

5.11.1 Design and Calculation Standards

Generally, for design, stress calculation, manufacture and installation, the following standards and codes, besides other relevant standards and regulations, shall be applicable:

- DIN 4'100 Welded Steel Structures
- DIN 4'114 Steel Structures: Stability (pp. 1 and 2)
- DIN 15'018 Cranes, Steel Structures, Calculation and Design

- DIN 15'020 Rope Drives Safety devices for the operating personnel
- CMAA Crane Manufacturer's Association of America

Safety devices for the operating personnel shall be provided wherever it is deemed necessary.

The safety rules outlined in VBG 8 of the German "Verband der Berufsgenossenschaft" or similar internationally recognised codes shall be observed.

Unless otherwise specified, the lifting equipment shall be classified to DIN 15020 as follows:

- For lifting capacity up to 100 kN (10 tonnes) "class 2 m", representing an average daily working time of 2 to 4 hours and an equal share of small, medium, and heavy loads (normal duty);
- For lifting capacity above 100 kN (10 tonnes) "class 1 Am", representing an average daily working time of 2 to 4 hours and a small share of heavy load lifts (light duty).

The Contractor shall state the various load combinations and factors of safety taken as a basis for calculation of the different components of the crane. In addition, the various factors of safety for the different load combinations shall be stated.

Each lifting equipment such as cranes or elevators shall be subject to a test operation with an overload = 1.25 x nominal load.

The crane girders and rails shall be calculated for a deflection not exceeding 1/1000 of the span at maximum nominal load.

Steel structures of lifting equipment shall be of welded construction, which can be assembled at Site. All field connections and joints shall be bolted.

For maintenance and inspection, appropriate ladders, platforms and steps shall be provided, fitted with anti-slip chequered plates, tabular handrails and skirting. Walkways, stairs and platforms for lifting equipment shall generally be designed for a service load of 3000 N/m^2.

For hand operation a handle shall be provided to allow operation under the disconnecting condition from electrical system and the operation force on the handle shall be less than 100 N per man, at the handle diameter of 600 mm which shall be located within 600 to 800 mm in height from the base.

5.11.2 Material Standards

The material to be used for manufacturing lifting equipment (steel structures) shall conform to DIN EN 10'025 or to the equivalent ASTM standards. However, the Contractor shall restrict the structural steel to FE 360 B and FE 510 C or ASTM A 36; the latter may be regarded as

equivalent to FE 430 C. For these structural steels, connecting bolts and welds, the allowable stresses given in DIN 15'018 shall apply.

If the Contractor intends to supply material other than that mentioned above, he can do so, provided their equivalence to the specified material standards is verified by the Contractor and approved by the Engineer in charge.

The stresses between the track rails, their fixing elements and the concrete shall not exceed the following values:

Mean allowable compressive stresses	6	MPa
Allowable compressive stresses on edges	10	MPa
Allowable bond stresses	0.6	MPa

The stresses induced by maximum torque shall not exceed 80% of the material yield point.

5.11.3 General Design Particulars

Nameplates stating the nominal capacity in tonnes shall be attached to both sides of the lifting equipment structure and to both sides of the tackle. The printing shall be clearly legible from the floor.

Hoists, ropes, drums, sheaves and related Works shall be calculated to DIN 15'020 or equivalent standards.

Flexible couplings shall be installed to relieve the bearings and shafts from any stresses due to misalignment and to facilitate the removal of motors, wheels and gears. The motor couplings also shall be of the flexible type.

All couplings drive wheels and gears shall be press fit and keyed to the shaft.

All wheels shall have a hardened tread with a minimum Brinnel hardness number of 400, and shall be made of carbon steel or low-alloy steel forgings. They shall have double flanges, shall be machined to a uniform diameter concentric with the hub bore.

All bearings shall preferably be anti-friction bearings designed to permit easy shaft disassembly and easy replacement. The minimum average lifetime under design load conditions shall be 5000 hours.

All sleeve bearings except those for the hooks and rope sheaves shall be lubricated by central lubrication systems. An independent system for the trolley and one or two independent systems for the bridge will be acceptable. These central lubrication systems shall satisfy the following requirements:

- The lubricant quantity for each bearing shall be variable
- Lubricant filters shall be installed in every lubricating pipe
- The lubrication piping shall be arranged to be easily accessible for maintenance

Gears shall preferably be designed as bevel gears. For all high-speed gears and pinions, oil bath lubrication shall be provided. Low-speed gears may be lubricated with soft grease. Suitable oil and grease drip pans shall be installed and be readily accessible for draining and cleaning.

Bridge and trolley drives shall be equipped with a spring-set, electrically (solenoid or electro-hydraulic) released shoe or disc brake, with capacities of at least 1.5 times the full operating torque of the drive.

The brake shall be applied when the motor control switch or the main switch is in the "off" position and/or in case of power failure in any phase. The braking action shall be gradual and the brake shall become fully effective after a certain time lag.

5.12 STEEL STRUCTURES

Generally, design and stress calculation shall conform to:

- DIN 1'050 Steel Structures, Construction
- DIN 4'100 Welded Steel Structures, Calculation and Design
- DIN 4'114 Stress Calculation of Steel Structures
- DIN 18'800 Steel Structures, Calculation and Construction

For standards applicable to steel structures of lifting equipment, refer to "Lifting Equipment".

The permissible design stresses for materials, bolts, rivets, etc. are given in DIN 18'800.

Adequate clearance of at least 2 m shall be provided at overhead steel structures to allow unobstructed passage.

Stairs and ladders shall have an inclination of approximately 30 degrees and 75 degrees respectively. Stairs shall be complete with handrails, min. 90 cm high, and kickboards of 8 cm height.

Vertical ladders shall be installed alternating left hand/right hand side to horizontal platforms placed approx. every 10 m of vertical height. Vertical ladders of more than 2.5 m height shall be guarded.

Load assumptions for ordinary platforms shall be:

- For platforms used by personnel and for support of light equipment with single weights of less than 1000 N and 5000 N/m2
- For all other platforms 5000 N/m^2

Unless otherwise specified or stipulated in the applicable standards.

Platforms and stairs shall be provided with anti-slip chequered plates.

The materials used for general steel structures shall conform to mild steel FE 360 B and FE 510 C or ASTM A 36.

6. ELECTRICAL WORKS

6.1 GENERAL

The electrical items of Works of any electrical or mechanical installation to be provided under this Contract according to the Particular Technical Specifications shall - if not stated otherwise therein-fulfil the requirements of this Section.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components with ease and speed.

The Works shall be pre-assembled to the highest possible extent in the Contractor or Sub-Contractor's works, complete with all devices and wired up to common terminal blocks.

The power supply and control cables shall be laid up to these common terminal blocks. The required control and protection devices, instruments, etc., within the different scopes of work shall be supplied and connected by the relevant Contractor.

Unless otherwise agreed, ratings of main electrical Works (in feeds, bus-ties) as selected or proposed by the Contractor, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Contractor shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.

Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g., upon failure of the corresponding main protection device and time delayed fault clearing by the back-up protection device.

All Works shall be suitable for the prevailing climatic conditions.

Outdoor installations needing protections shall be protected against solar radiation by means of adequate covers, where required.

The Contractor shall ensure that all the equipments and devices are insensitive to any signals emitted by wireless communication equipment.

6.2 STANDARDS

The design, manufacture and testing of all Works and installations shall strictly comply with the latest edition of the relevant IEC standards or any other international standards.

6.3 COLOUR CODE

In general, the colour code for electrical Works shall be as described in the Particular Technical Specifications.

The manufacturer's painting systems shall be used to the maximum possible extent, but shall by all means be subject to the approval of the Engineer. Final coats of paint shall be matching adjacent installations, where required.

6.4 ELECTRIC MOTORS

6.4.1 General

All motors shall be of approved manufacture and shall comply with the requirements of this Chapter. Motors of the same type and size shall be fully interchangeable and shall comply - as far as applicable - to IEC standard motor dimensions.

The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.

All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.

AC motors shall have squirrel cage type rotors.

Motor Voltages and Power Ratings

The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:

- Motors up to 100 kW
- Service voltage : 3-phase a.c. 415/240 V,50 HZ
- Mode of starting : direct-on-line up to 50 kW

Above 50 kW with suitable starters

- Motors up to 0.75 kW
- Service voltage : single-phase a.c. 240 V, 50 HZ
- Mode of starting : condenser
- Motors intended to work on the d.c. System
- Service voltage : 220 V D.C.
- Mode of starting : resistor

6.4.2 Rating

The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

Power Demand of Driven Machine	Service Factor
Up to 5 kW	1.2
More than 5 kW	1.1

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

6.4.3 Starting

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite bus bar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary bus bars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

The maximum starting currents (without any tolerance) shall not exceed the following values: -

- 5 times of rated current for low voltage motors rated 100 kW or above
- 2 times of rated current for D.C. motors (by means of starting resistors)

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each medium voltage motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each low voltage motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

6.4.4 Windings and Insulation Class

The insulation of all motors shall be of class F but will not exceed the temperature limits of class B materials in operation. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature.

The stator winding shall be suitably braced to withstand the forces due to direct-on-line starting and transfer conditions as mentioned before. The winding envelopment and tails shall be non-hygroscopic. The stator winding shall withstand the maximum fault current for the period determined by the associated protective devices.

The rotor winding (if applicable) shall be designed to give trouble-free continuous service including repeated direct-on-line starting. The rotor shall be subjected to a 120% over speed test for 2 minutes without showing any winding dislocation.

6.4.5 Ventilation and Type of Enclosure

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

They shall have a closed internal cooling air circuit re-cooled by an external cooling air circuit drawn from the opposite side of the driving end.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box.

Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields.

Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

6.4.6 Bearings

As far as possible, the motors shall have sealed ball or roller bearings. All motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and for preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Where sleeve bearings are being used, they shall be of the self or forced lubricating type. If forced lubrication is required, it shall be arranged common to both the motor and the driven machine and provisions shall be made to ensure lubrication during start-up and

shutdown operations without the necessity to start an auxiliary lube oil pump. Self-lubricated bearings shall be equipped with an easily accessible oil reservoir with overflow pipe and oil collecting vessel.

All bearings shall be easily controllable during operation or standstill without dismantling the bearings. The bearings shall further be protected and sealed against dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

For the transport of motors equipped with ball or roller bearings, special bearing inserts shall be provided to prevent transport damage.

6.4.7 Shafts and Couplings

The motors shall be provided with a free shaft extension of cylindrical shape with key and keyway according to IEC Recommendation 72-1 and with the motor side coupling, which shall be pressed on the motor shaft and be balanced together with it. A coupling guard shall be provided.

6.4.8 Brush gear and Commutators

Brush gear for D.C. motors shall be designed to ensure constant brush pressure. Carbon brushes shall be provided which stand at least 6 months of operation without replacement. Each brush shall be independently adjustable but should not require adjustment throughout its life. A design of brush gear which permits the brush holder to touch the commutator as the brushes wear or which passes current through the pressure fingers will not be accepted.

A sufficient number of brushes, not less than two per pole, shall be fitted to ensure that vibrations do not affect the commutation.

The minimum safe wearing margin of commutators shall not be less than 20 (twenty) per cent of the total thickness of the commutator bars and the minimum safe diameter shall be clearly marked on it.

6.4.9 Terminal Boxes and Earthing

The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.

The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation, this shall be clearly indicated.

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing-end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

The cable termination philosophy to be adopted shall be such that extensive grouping of signals by a large scale use of field-mounted group. Junction boxes at strategic locations (where large concentration of signals are available, e.g. switchgear) is done. Termination / Junction boxes shall have either maxi- terminal or cage clamp type terminals

6.4.10 Noise-Level and Vibrations

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

Vibration displacements or velocity shall be measured in accordance with DIN 45 665 for IEC motor sizes 80 to 315. The results for all motors shall be within the "R" (reduced) limits.

6.4.11 Tests

Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

- Workshop Tests:
- Measurement of winding resistances
- No-load and short-circuit measurements
- Measurement of starting current and torque
- Efficiency measurement (type test)
- Heat test run
- Dielectric test
- Measurement of insulating resistance

- Over speed test
- Site Tests:
- Measurement of insulation resistance
- Measurement of motor vibrations
- Measurement of starting time.

6.5 M.V. AND L.V. SWITCHGEAR, CUBICLES AND PANELS

6.5.1 Starters and contactors

Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices. Preferably, all starters shall be from one manufacturer. The control circuit voltage shall be obtained from a 415/240 V isolating transformer with primary circuit breaker and secondary fuse. The secondary winding of this transformer shall be grounded. The operating coils of the contactor shall be connected between the grounded side of the transformer and the control contacts.

Starters and contactors shall comply with IEC 292.1 or NEMA IC 1 and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour. They shall be installed in ventilated enclosures for indoor installation and weatherproof enclosures for outdoor installation, unless otherwise approved by the Engineer. The enclosures shall be complete with locks, cable sealing boxes, conduit entries, cable gland plates, bus bars, internal wiring, terminal boards, etc. as required by the duty of the starter or contactor.

Starters and contactors shall be of minimum size compatible with motor size and capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 percent below nominal, at nominal frequency.

Thermal type overload and phase failure relays shall be supplied with starters for motors of 7.5 kW or greater. For motors of less than 7.5 kW, suitable rated 3-phase thermal overloads will be acceptable. Ammeters to read current in one phase shall be provided for motors above 7.5 kW.

Each starter shall have sufficient number of auxiliary contacts required for interlocking and indication purposes plus two spare convertible contacts for Owner's use.

6.5.2 Moulded case circuit breakers

All moulded case circuit breakers shall be of 2 or 3-pole type as required, having thermal time delay and instantaneous trips with "On-Trip-Off", indicating/operating mechanism. Circuit breakers used in combination type motor starters or contactors shall have the operating mechanisms interlocked with the starter or contactor cover so that the cover cannot be opened unless the circuit breaker is open. The

breakers shall comply with applicable section of IEC 157/1 or equivalent standards.

6.5.3 Control relays

Relays used as auxiliary control devices in conjunction with motor starters and magnetic contactors shall be of the type designed for machine tool application featuring contact convertibility. All contacts shall have a minimum thermal current rating of 10A over a range of 6 to 600 V AC.

6.5.4 Pilot devices

Pilot devices such as selector switches, push-button starters and thermostats shall be of heavy duty type and, where mounted outdoors, shall be housed in weather proof enclosures specially designed for the environment.

All electrical contacts for control, alarm and shutdown shall have a thermal current rating of not less than 10 A at 220 V DC.

6.5.5 Terminal blocks

All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

Terminal blocks shall conform to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm wire and not more than two conductors shall be connected under one terminal clamp.

Terminal identification shall be provided corresponding to wire number of connected leads.

Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with noninflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

6.5.6 Equipment wiring

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly dressed inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipments.

Multi conductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilising slip-on ferrules approved by the Engineer.

Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.

All trip circuits shall employ markers having a red background.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

6.5.7 Cubicles and control panels

Cubicles and control panel enclosures shall be of sheet steel with minimum thickness of 1.8mm, of rigid, self-supporting construction and supplied with channel bases.

Cubicles shall be fitted with close fitting, gaskets, hinges, lift-off doors capable of being opened through 105 degrees. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable

extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm^2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

6.5.8 Alarm contacts

Where applicable, all alarm contacts shall be of galvanically isolated type and provide inputs to the following devices.

- -Local annunciator
- -Station annunciator
- -Supervisory control and sequence of events / fault recorder system.

All alarm contacts shall be changeover type. Where required, relays shall be provided as contact multiplier.

6.6 CABLES

Refer to particular technical specifications Section-IX.

6.7 EARTHING SYSTEM

The contractor of Electro-Mechanical Equipment will make the design calculation and supply the necessary material and install the earthing system during powerhouse construction in co-coordination with civil contractor

6.8 EXPLOSION PROOF WORKS

6.8.1 General

According to the kind of oils and fuels used, explosion in hazardous locations may be caused by standard type electrical works. Therefore, the installation in such locations shall generally be kept to a minimum with said works designed or installed in compliance with the latest issue of IEC recommendation 79 and the appropriate articles of the American National Electric Code (NEC) or the German VDE Standards 0165, 0170 and 0171.

6.8.2 Definition of Hazardous Locations

Hazardous locations shall be defined as follows:

- Class 1, Div. 1 locations are those:
- Where hazardous concentrations of inflammable vapours or gases exist continuously, intermittently, periodically under normal conditions of operation and maintenance and with normal leakage, and
- Where the breakdown or faulty operation of process equipment could release explosive concentrations of fuel and cause simultaneous failure of electrical works.
- Class 1, Div.2 are those:
- Adjacent to Div.1 locations which may occasionally be reached by hazardous concentrations, and
- Where inflammable volatile liquids or gases are handled, processed, or used, but where concentrations are not normally hazardous because liquids or gases are handled in closed systems, and
- Where hazardous concentration is normally prevented by positive ventilation. These locations become hazardous only when the ventilation system fails.

6.8.3 Design features

The design features of electrical works and /or circuits to reach explosion proof condition shall be selected with due regards to the place of installation and the kind of works.

The main features shall be as follows:

- Pressure & flame –proof Enclosure:

All parts, which may ignite a hazardous atmosphere, shall have an enclosure of sufficient strength to withstand the maximum pressure caused by ignition of the most inflammable mixture of the gas involved. All necessary joints of such enclosures shall be provided with long fits (minimum 25 mm) and close clearances (equal or smaller than 0.6 mm) to cool the escaping flame and to prevent flame propagation to the outside atmosphere.

- Oil Immersion:

The parts capable of igniting inflammable or explosive mixture shall be immersed in oil to such an extent as to prevent ignition of explosive mixtures above the surface of oil by means of sparks or hot gases produced under oil.

- Increased Safety:

To obtain an increased degree of safety on electrical works, special measures shall be taken to prevent non-permissible high temperatures, sparks or arcs inside or outside of the works on which they don't occur under normal working operations.

- Intrinsic safety

All electrical circuits or part of such a circuit shall be considered as intrinsically safe if neither during normal working operation nor under fault conditions explosive mixture is ignited by means of arcs, sparks or any heat generation.

- Any other approved feature not mentioned above but may be felt necessary during the course of execution.

All explosion proof works shall be of approved design and must have undergone type tests according to appropriate standards.

The selection of such works with reference to design features and allocation to hazardous groups shall be subject to approval by the engineer.

6.9 LABELS AND PLATES

6.9.1 General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer-in-charge for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

6.9.2 Equipment Labels and Instruction Plates

Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.

All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).

Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

6.9.3 Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.

For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

Details are stated in the Particular Technical Specifications or will be fixed at a later date.

6.9.4 Labels for Conduits

The material shall be non-corrosive and the inscription be done with 4 mm high letters/figures.

6.9.5 Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer-in-charge, non-corrosive labels detailing identification number of the cable, voltage, and conductor size.

The cable identification numbers shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

6.9.6 Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

6.9.7 Single-Line Diagrams

Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board / MCC, placed under glass and frame/wall mounted at an approved location.

The same applies to the Station Single-Line Diagram one copy of which shall be arranged in the control room(s).

6.8 KEY SYSTEM FOR ELECTRIC BOARDS

Key interlocked switches shall be provided with Yale or other approved locks for locking in the neutral position. Similar locks shall be provided for selector switches for locking the switches in any of the positions.

The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. A key cabinet at the end of each board (distribution board, MCC, control cubicles, etc.) shall be provided for storing the keys of that board. All keys shall have six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key-hanging hook inside the cabinet.

The cabinet door keys shall be similar and shall be six (6) in number.

7. INSTRUMENTATION AND CONTROL EQUIPMENT

7.1 GENERAL

All instrumentation and control equipment shall be of internationally reputed make having proven performance and acceptability in the field.

7.2 DESIGN CRITERIA

7.2.1 General

Chapter 6, "Electrical Works", shall be considered for I & C equipment as far as applicable. Special reference is made to cabling, wiring and labeling.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.

The Works shall be pre-assembled to the highest extent in the Contractor's or Sub-Contractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carried out. Fragile instruments shall be removed for transportation to site.

All components shall be suitable for continuous operation under site conditions.

Materials for instrumentation and control equipment, including piping material, which is exposed to the measured media, shall be selected accordingly.

All components shall be compatible with other electrical, electronic and mechanical Works.

All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the Works identification system and is subject to approval by the Engineer. All measurements and alarms shall be listed in a measuring list of a standard form subject to Approval by the Engineer. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.

Shielded cables shall be provided for the control and supervisory equipment where required.

7.2.2 Standards

If the Contractor intends to apply Standards and Regulations other than those specified, he shall provide the Engineer-in-chargewith two (2) sets of such documents, which shall be complete, unabridged and written in the Contract Language.

7.2.3 Sizes of Indicating Instruments and Recorders

The meters, instruments and recorders shall be of standard size, to be selected to guarantee aesthetic appearance of switchgears, control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90 degrees type for local control panels but must be 240 degrees type for control room instrumentation.

The control switches, adjusters, etc., on the panels and desks shall harmonise with the utilised indicator sizes.

7.3 TESTS

The single components and pre-erected assemblies shall undergo functional and routine tests in the Contractor's or Sub-Contractor's workshop. The ready mounted control and supervisory system shall undergo functional tests on Site prior to commissioning of the power Works.

Calibration tests shall be made on all-important pressure gauges and other instruments as required by the Engineer in charge.

7.4 MEASURING SYSTEMS

Electric measuring signals of 4-20 mA shall be transmitted to the control room for emergency or regulating circuits. In this case the absence of live zero signal shall lead to a warning signal. Measuring signals for indicating purposes will be 4-20 mA.

The components shall quickly respond to any changes of the measured magnitudes. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured magnitude covers approx. 75% of the range.

All local instruments shall, as far as practicable, be mounted vibration free to allow good reading. Wherever required, damping elements shall be used.

Corresponding systems shall be grouped together in local panels.

All local indicating instruments and test connections shall be included in the respective Works as integrated parts. The scope of local indicating instruments and test connections shall enable the operator to properly survey the Works, and shall also allow to adequately carrying out all acceptance and other tests.

The binary sensors shall be fused separately and supplied with 24 V D.C.

7.4.1 Flow Measurements

The primary elements of flow meters shall be standard Venturi tubes, pitot tubes, standard orifices, anubar inductive , Electro-Mangetic Type or ultrasonic type. Their design and performance shall be in accordance with applicable standards.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDI/ VDE rules 3512.

Beginning at a rate of flow of at least 5% of the measuring range all flow transmitters shall measure correctly. The error limit shall be ±1% for a rate of flow higher than 10%. The error of the primary elements is not included in this accuracy. The root extraction of flow measurement shall be effected electrically within the transmitter.

Arrangement:

The arrangement of the throttling devices, the straight lengths upstream and downstream from the throttling device shall be in accordance with the said standards. Bends shall be at a sufficient distance upstream from the throttling device, particularly when large orifice ratios are used.

7.4.2 Temperature Measurements

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells shall be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80 °C, and the measuring inserts are easily exchangeable.

The temperature sensors shall be selected in such a way to minimise the number of different spare inserts. Resistance thermometers shall be used as far as possible and shall generally be of type Pt 100. Double resistance thermometers (with two resistors in one insert) should be avoided.

The use of dial-type contact thermometers shall be restricted to bearing metal and oil temperature measuring. In all other cases, thermocouples or resistance thermometers and electric contact modules (monitors) shall be used. Glass thermometers and similar thermometers will not be accepted as contact thermometers.

7.4.3 Pressure Measurements

Pressure gauges shall be shock and vibration-proof (preferably by filling with glycerin) and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel.

Higher than rated pressure shall not deteriorate the pressure gauge or affect its calibration. The pressure gauges shall be equipped with a radial-connecting stud, to allow the mounting on a gauge holder.

Pressure gauges with potentiometers will not be accepted for use as a pressure transmitter.

The error for pressure transmitters shall be limited to ±0.5%.

Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.

Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20 x 1.5 mm so that such device can be removed without any disturbance of the plant operation.

Pressure gauges and transmitters for pressures of 10 bar and above shall not be directly mounted on the pressure tapping point. They shall be mounted apart from the tapping point on gauge holders or gauge boards. Whenever possible, pressure gauges and transmitters shall be group wise combined on racks or consoles.

Pressure gauges for high pressures shall be equipped with a relief valve for safety reasons in case of leaks (with a rubber reverse flow check).

In case of flowing substances, the measuring point shall be selected in locations of undisturbed flow.

If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse-absorbing means.

In general, all pressure gauges, transmitters and pressure contacts shall easily be accessible for maintenance and supervision.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDI/VDE rules 3512.

The scales shall have a diameter of 150 mm with black letters and figures on a white background. The calibration shall be in "bar".

The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.

The high and low-pressure connections of differential pressure gauges shall be marked accordingly.

All casings shall be dust and watertight and be made of stainless steel.

7.4.4 Level Measurements

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of pressure transmitter of mercury less-type, by displacement-type transmitters or float-disc-transmitters. The errors shall not exceed ± 1.0% of the total measuring range. Level switches shall be of the externally mounted float or displacement operated type. The switch shall be of packing less construction; there shall be a minimum of moving parts.

7.4.5 Electrical Measurements

All Electrical instruments shall be of flush mounted design, dust and moisture-proof. A.C. ammeters and voltmeters shall have digital type system of not less than 1.5 accuracy class for connection to the secondary side of instrument transformers. D.C. measuring instruments shall have digital type systems of the same accuracy. Watt meters/energy meters shall have electro-dynamic measuring

mechanisms if fed by transmitters. Watt meters shall be suitable for unbalanced systems and accuracy of energy meters should be of 0.2 % accuracy class.

All indicating instruments shall generally withstand without damage a continuous overload of 20% referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault-currents within the rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.

All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instruments and apparatus shall be rear connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protected by MCB's in the unearthed phases of the circuit, installed as close as practicable to the instrument transformer terminals, or, where instruments are direct-connected, as close as practicable to the main connection. All power factor indicators shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the current transformer secondary windings.

When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.

All instruments shall be of the flush mounting type and shall be fitted with non-reflecting glass and shall comply in every respect with the requirements of IEC Publication 51. Except for instruments employed for Works performance tests all instruments shall have an accuracy class of 1.5.

Scales shall be arranged in such a way that the normal working indication is between 50-75% of full-scale reading permitting an accurate reading. CT connected Ammeters provided for indication of motor currents shall be provided with suppressed overload scales of twice full scale. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.

Instrument scales shall need the approval by the Engineer-in-charge. All instruments mounted on the same panel shall be of same style and appearance.

Transmitter connected ammeters (for example those in mosaic-type control desks) shall have 90 degrees or 240 degrees circular scales calibrated 0-120 %. The rated motor current shall correspond to 100% scale indication.

All metering circuits shall be terminated in marked terminal blocks for remote metering purposes.

7.4.6 Position Measurements

Position transmitters of the potentiometer type will not be accepted. Inductive or capacitive type shall be provided.

Position transmitters for continuous position indication and measuring transducers shall have an output current of 4-20 mA and aux. supply voltage (if required) 220 or 48 V D.C. The "potentiometer-type" position measuring principle is not permitted.

7.4.7 LIMIT SWITCHES

Limit switches shall be provided for each electrically operated gate, valve or gantry to automatically stop the motor at both ends of travel. Additional switches shall be provided where necessary for control, interlocks and indication.

Limit switches shall be mounted suitable for easy adjustment and for rigidly locking in position after being adjusted. They shall be of heavy-duty rating and have two changeover contacts suitable for 220 V D.C. operations.

Switch fixings shall be positive and shall be unaffected by vibration. At the same time they should be capable of easy adjustment to suit changing parameters of the associated plant.

Particular attention shall be paid to potentially harmful environmental conditions, including water, oil, dust, dirt, temperature variations and differential expansions. Where switches operate through linkages, precautions shall be taken to eliminate variations of settings and incorrect operations resulting from wear or tolerances.

7.4.8 Contact Devices

Contacts of level switches, pressure switches, temperature switches, limit switches, and of all other devices shall be of the snap action type (SPDT). Contact devices for interlocking systems shall be separate, i.e., contact devices serving commonly for interlocking and other purposes will not be accepted.

7.5 PROTECTION SYSTEMS

Electrical/Mechanical Protection and Interlocking Systems shall be provided for all works components and individual systems to ensure a safe and reliable operation and to limit harm and damage to personnel and works to an utmost extent.

The primary functions of these facilities shall be to disconnect selectively faulty sections of the systems prior to influence or damage to other works and to maintain operative systems as far as possible.

Moreover these devices shall facilitate the duty of the operation staff and prevent mal-operation.

7.6 TRANSMITTER RACKS AND PIPING

Wherever practicable, transmitters for flow, pressure, etc., shall be installed in readily accessible positions in the proximity of the measuring point, free from vibration and protected against damage, moisture, dust, corrosive air, and great temperature changes.

The transmitters shall be grouped and assembled as far as practicable on local transmitter racks or in cubicles with glass or plexi-front.

The connecting lines between the primary elements and the transmitters shall be installed to falls in order to ensure that no air pockets or water locks are created.

8. TRANSPORT AND INSTALLATION

8.1 GENERAL

Shipping, loading, transportation, unloading, storage, erection and test running shall be performed by the Contractor. The Contractor is required to carryout survey for obtaining the transportation limitation data on its own.

From the time of manufacturing until commissioning all parts of the plant shall be protected and insured at the Contractor's expense against damage of any kind. Parts, which are damaged during transport, storage, erection or trial operation, shall be replaced at the Contractor's expense.

The Contractor shall provide the Engineer-in-charge with complete packing lists of each performed shipment.

8.2 PACKING

The contractor shall prepare all plant, devices & materials for shipment to protect them from damage in transit, & shall be responsible for make good all damages due to improper preparations, loading or shipment.

After the workshop assembly & prior to dismantling for shipment to the site, all items shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so they are clearly visible.

Dismantling shall be done into convenient sections, so that the weights & sizes are suitable for transport to site & for handling on the site under the special conditions of the project.

All individual pieces shall be marked with the correct designation shown on the Contractor's detailed drawings and other documents (packing lists, spare part lists, in Operating and Maintenance Instructions, etc.).

Marking shall be done preferably by punching the marks into the metal before painting, galvanising, etc., and shall be clearly legible after painting, galvanising etc. In labeling, the Contractor shall endeavor to use as few designations as possible and each part of identical size and

detail shall have the same designation, regardless of its final position in the plant.

All parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc.

All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high-pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

The Engineer-in-charge reserves the right to inspect & approve the packing before the items are dispatched but the contractor shall be entirely responsible for ensuring that the packing is suitable for transit & such inspection will not exonerate the contractor from any loss or damage due to faulty packing.

All packing costs shall be included in the scope of Work.

8.3 MARKING

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

- Consignee :
- Contract No. :
- Country of Origin :
- Port of entry :
- Item number (if applicable)
- Package number, in sequence
- Quantity per package :
- Description of Works :
- Net and gross weight, volume :

8.4 TRANSPORT AND STORAGE

The Contractor shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Contractor shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.

The Contractor shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc.

All parts of the plant shall be brought, as far as possible, to their final place of erection. The Contractor shall construct his own storage facilities at site.

The warehouses shall be weatherproof, with good ventilation and solid floors. The floors of the warehouses and storage areas shall be designed to carry the loads imposed on them by the stored parts. The following parts shall be stored inside enclosed warehouses:

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors and excitation equipment, instruments, welding material and equipment, all small parts and all parts of the plant which already have been finally painted.

If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts, which are not packed in heavy-duty polyethylene foil and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation.

All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity.

All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers.

8.5 PREPARATION AND INSTALLATION

Prior to commencement of installation, the Contractor shall closely inspect the site and all the foundations and other structures on which parts of the plant supplied under this Contract will be installed; he shall check that the foundations conform to the installation drawings.

The result of this check shall be reported to the Engineer in due time to allow any errors to be corrected before the commencement of erection. All parts of the plant shall be cleaned carefully of all contamination such as dust, sand, rust, mill scale and other dirt prior to installation.

8.6 REFERENCE POINTS

The Contractor shall employ a competent surveyor for setting-out of all datum lines including the constant checking and maintenance of the setting-out until the completion of his works.

The Contractor shall provide all necessary pegs, profiled templates and centre lines and shall establish all such permanent markings and recovery marks as may be required by the Engineer for checking the Contractor's setting-out. The Contractor shall be responsible for rectifying, at his own cost, all work rejected by the Engineer-in-charge due to errors in setting-out.

All bench marks, notch marks, pegs and signals on the surface, alignment pins and the like put in by the Engineer for the purpose of checking the Contractor's work or as permanent survey marks will be under the care of the Contractor during the period of the Contract. He

shall, at his own expense, take all proper and reasonable care and precautions to preserve and maintain them in their true position where such marks are within or adjacent to his work area. In the event of their being disturbed or obliterated by any cause whatsoever, they may, if so determined by the Employer, be replaced by the Engineer-in-charge at the Contractor's expense.

The Contractor shall be responsible for the true and proper staking-out of the works and levels of reference given by the Engineer in writing, for the correctness of the positions, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection with this.

The checking of any staking-out or of any line or level by the Engineer-in-charge or the Engineer's Representative shall not in any way relieve the Contractor of his responsibility for its correctness.

8.7 GENERAL NOTES ON INSTALLATION WORK

All transportation and handling of the plant from the place of storage to the place of installation shall be carried out by the Contractor. He shall provide all hoisting equipment, staging and scaffolding, winches and wire ropes, slings, tackles and all other appliances and temporary materials. The erection staging and scaffolding shall be provided with coverings and barriers and shall guarantee safe working conditions.

The Contractor shall comply with all applicable and approved safety regulations while carrying out the works on Site and with all reasonable requirements of the Engineer. This stipulation shall in no way release the Contractor from any obligation concerning his liability for accidents and damages. He shall be responsible for adequate protection of persons, plant and materials against injuries and damages resulting from his operations.

The plant or parts to be installed shall not be overstressed during the process of installation.

The Contractor shall be responsible that the installation of all plant is properly executed to the correct lines and levels and in accordance with the manufacturer's instructions and the Contract requirements.

The alignment of the plant shall be done exactly; the tolerances indicated by the Manufacturers or in the drawings shall be kept.

Setting of parts to be aligned shall be performed by means of fine measuring instruments. All erection clearances and settings shall be recorded. Copies of these records shall be given to the Engineer-in-charge. After alignment, the parts shall be held firmly in position by means of set pins, fitted bolts, etc.

All parts to be embedded in concrete shall be set accurately in position and shall be supported rigidly to prevent displacement during the placing of concrete. Adjusting screws and bolts shall be drawn tight and secured adequately. Steel wedges shall be secured by welding. Wooden wedges shall not be used.

The Contractor shall verify carefully the position of all parts to be embedded before concrete is poured. All important measurements and dimensions shall be recorded. Copies of these records shall be given to the Engineer-in-charge for checking and approval before items are built-in to the Works.

After concreting, the control measurements shall be verified again, indicated in the above-mentioned records and submitted to the Engineer-in-charge.

The Contractor shall provide all necessary anchors and braces to ensure the alignment and stability of the parts to be installed. All temporary anchors and bracings shall take care of all dead load, wind load, seismic and erection stresses, e.g., during concreting, and shall remain in place until they can be removed without endangering the stability of the plant.

Welding, torch-cutting and drilling work on the plant to be erected shall only be carried out with the approval of the Engineer-in-charge only for modification if any.

If for installation purposes auxiliary structures have been attached to the plant, they shall be removed after completion of work and the surface restored to proper condition by grinding and repainting.

Special care shall be taken not to damage surfaces of galvanised or specially treated plant during erection. Care shall be taken to prevent or remove any rust streaks or foreign matters deposited on galvanised or otherwise finished surfaces during storage or transport or after installation.

Glass parts or other parts, which can easily be damaged, shall be provided with suitable protective sheaths or coverings during installation.

Machined or bare metal surfaces, which are to receive no coat of paint, shall be protected during transportation, storage and erection by a suitable anti-corrosion film.

All power tools preferably be operated pneumatically. They are to be handed over at the end of the installation work in good condition in accordance with the instructions of Engineer-in-charge.

After erection, the works shall be finally painted, in accordance with the painting specification, and any damaged paintwork shall be restored.

The Contractor shall keep the site in clean condition during erection and commissioning time. On instruction of the Engineer-in-charge, he shall remove waste from the place of installation to the defined deposit site at his own cost.

8.8 CIVIL WORK AT SITE

The following works shall be carried out as part of the civil works and is included within the scope of work covered by the equipment specifications :

- Dismantling of the required equipment (including civil work) as per the scope of work.
- All concrete work, including reinforcement and form-work, and all grouting required for filling in, around and under the various parts of the works to be embedded in concrete.
- All necessary excavation and backfilling required for installing the plant in its final position, unless otherwise stated in the Technical Specifications.
- Providing and grouting the block outs for all anchoring and foundation bolts needed to support and fix the plant in its final position.
- All protective measures, e.g., pumping, etc., to keep the various parts of the plant and the erection site free from water during the time of erection.
- Provision of cable and pipe ducts, trenches, block-outs, etc., in accordance with the drawings.
- Adequate safety covers and protective measures against injury or damage to the Contractor's employees and equipment and to the works due to any operations of the contractor.
- If chequer plates or other covers provided under the contract require special care for fitting to plant and installations, such work (cutting, matching, welding of supports, etc.) shall be performed by the contractor.

9. INSPECTIONS AND TESTS

9.1 GENERAL

In addition to the provisions established in the Conditions of Contract regarding general procedure of inspections and tests, terms and definitions, and time schedules for inspections and tests the following stipulations shall apply.

Approval of assemblies, tests, inspections, related procedures etc. and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

Three (3) sets of all test records, test certificates, performance curves, tables etc. of all inspections and tests, whether or not attended by the Engineer-in-charge shall be supplied soonest after performance of each inspection or test. After completion of all tests, two (2) sets of the

above-mentioned documents shall be supplied, properly bound in books.

All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.

In addition, the following references shall be entered in the top right-hand corner:

- Employer's name
- Project title
- Plant's (stage's) name
- Number of Contractor's drawing
- Date

9.2 SHOP INSPECTIONS AND TESTS

As far as practicable, quality of materials, workmanship and performance of all items of the Works to be furnished under this Contract shall be inspected at the places of manufacture.

Where the Contractor desires to use stock material, not manufactured specifically for the Works, satisfactory evidence that such material conforms to the requirements of the Contract shall be submitted.

Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any painting work as well as transport to the site of the Works shall not be started before the approval of the Engineer-in-charge has been obtained.

Free and unrestricted access to the Contractor's factory and shops (including those of his Subcontractors) shall be granted to the Engineer-in-charge also and upon reasonable notice by the Engineer-in-charge if deemed necessary by the same for additional witnessing of assembly work or inspections and tests.

If an agreed inspection could not be carried out as proposed because of lack of preparation, obvious negligence or material and/or equipment being presented in a state, not corresponding to the proposed procedure or is clearly not acceptable such an inspection shall be repeated. The cost incurred by the Employer for repeated inspections shall be fully borne by the Contractor.

9.2.1. Material Tests

Unless otherwise specified, the quality of materials (new as well as the equipment parts to be retained) shall be verified generally by:

- Chemical analysis.

- Mechanical tests (yield point, tensile strength, elongation, and notch impact.)
- Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)
- Non-destructive x-rays, ultrasonic, magnaflux, liquid tests, penetration inspection, etc.).
- Electrical tests (voltage, losses, tan delta, insulation, magnetic properties etc.) Note : Tan delta on sample bar and PD on 100% generator bar .

Certified mill test reports of plates will be acceptable when these comply with the requirement of specifications. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent.

Castings and forgings shall be tested in the rough state in order to detect flaws in good time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the casting. After partial machining, further tests can be conducted.

Load tests on crane hooks, steel wire ropes, chains and other lifting devices, etc. shall be considered as material tests.

9.2.2 Checking of Dimensions

The dimensions, especially clearances and fits, (ISO 286) which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

- Run out and roundness tolerances of shafts, pistons, etc., to be measured on single parts as well as (wherever possible) on the assembled components,
- Fits and clearances of bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc.,
- Accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc.,
- Dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

9.2.3 Workshop Assembly

In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.

Works to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the Specifications, that the delivery is complete, and that no work remains to be done at Site, which reasonably can or should be done in the shop.

Where applicable, each item of the Works shall be assembled completely prior to painting.

Field joints shall be temporarily connected.

All parts shall be properly match marked, identified and dowelled where practicable, to facilitate correct and quick field assembly and alignment. Where necessary, suitable dowels shall be inserted, after field assembly and drilling. The holes for any fitted bolt shall be accurately reamed.

During workshop assembly all instruments, control devices and piping shall be fitted.

If the assembly shows defects in the design or manufacture or unforeseen difficulties in assembling and dismantling, these shall be eliminated. If required, design alterations or corrective measures can be executed provided that reliability of operation or interchangeability are not reduced and provided that the agreement of the Engineer-in-charge has been obtained.

If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Engineer-in-charge. Faulty parts or Works shall by no means be delivered.

The assembled parts shall subsequently be subject to tests as per applicable standards or required by the Engineer.

9.2.4 Pressure and Leakage Tests

All parts subject to internal or external pressure or containing any liquids or gases temporarily or permanently during operation shall be tested prior to painting. As far as practicable, these tests shall be done in the shop but can be repeated at site.

Parts exposed during operation to hydraulic pressure, to gas pressure or to any liquid without pressure, shall be treated distinctively.

In addition to the Specifications, the applicable and approved standards and official regulations shall be observed. If any liquid is used for the test that may cause corrosion, all Works and piping shall be thoroughly cleaned immediately after the test.

As far as practicable and required, the influences of temperatures and temperature differences to which the part will be exposed during operation shall be considered in the execution of the tests.

Leaks and defects can be repaired if permitted by the applicable standards and approved by the Engineer-in-charge. If defects are found, the Engineer-in-charge may reject the defective parts, or permit welding repairs with stress relieving, radiographic examination and additional pressure tests.

Parts Exposed to Hydraulic Pressure

Unless otherwise specified or required, the following shall apply: the hydraulic pressure tests shall be carried out using the liquid to be used during operation or a liquid with less viscosity.

The hydraulic test pressure shall be l.5 times the maximum operating pressure (except for spiral distributor) and shall be maintained for a period of eight hours or longer if required by the applicable standards. Afterwards the test pressure shall be reduced to the operating pressure.

The welded seams of large parts, which are not subjected to any heat treatment during or after welding, shall be rapped with a 500 g hammer during the pressure decrease or treated otherwise to obtain the required effect of stress relief.

Finally, the test pressure mentioned above shall be maintained for ten (10) minutes. Leakages appearing at seals, joints, etc. shall be measured and stated in the test report, together with the relevant pressures.

Parts Exposed to Gas Pressure

Parts which will be subjected to gas pressure during operation for example pressure tanks, pressure air tanks and others, shall be inspected and tested according to the official regulations with respect to design, construction, fittings, etc.

The pressure test shall be executed by applying the test pressure in accordance with the relevant standards and specifications.

Parts Exposed to Liquids without Overpressure

Parts which shall not be closed and which are exposed to only small pressures of any liquid during operation e.g., bearing housings, oil containers, etc. shall be subjected to a tightness test at with a suitable liquid of low viscosity. The testing-period shall not be less than 8 hours, unless otherwise agreed.

9.2.5 Functional Tests

Functional tests shall be defined as tests of the function of assemblies, sub-assemblies or parts of the Works under no load conditions. Functional tests shall be performed on all Works prior to the execution of operational tests.

9.2.6 Operational Tests

As far as practicable operational test shall be carried out on all Works, simulating operating conditions.Parts to be delivered by sub suppliers shall be tested either at the premises of the sub supplier or of the Contractor, as agreed by the Engineer-in-charge.

Before testing the Contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the Works to be tested and on the test facilities and equipment.

Testing of the electrical Works shall be performed in accordance with applicable Standards; they shall include but not be limited to tests of heating, loading, overloading, losses.

Operational tests of lifting equipment and other machinery shall include tests under nominal load and 125 % of nominal load unless otherwise specified.

9.2.7 Electric Tests

Electrical appliances/devices/equipment shall be tested in accordance with applicable Standards and agreed test programs and procedures.

9.2.8 Model Tests

Model tests for certain parts of the Work or Works shall be carried out as specified or agreed between the Contractor and the Engineer-in-charge as per specification defined in Chapter-2

9.3 SITE INSPECTION AND TESTS

During erection, commissioning and trial operation, the Contractor shall perform at suitable intervals all inspections and tests in the presence of the Engineer-in-charge in order to prove the orderly execution of the works in accordance with the Contract.

Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.

The Engineer reserves the right to have checked at his own expenses the Contractor’s instruments to be used or having been used for any tests by an independent, officially acknowledged institution.

Special tests to be performed at Site are listed in the corresponding chapter of the Particular Technical Specifications.

The Contractor's testing at Site shall be complete in every respect to prove the successful performance and operation of all the works and Works supplied and erected under the Contract.

In case of disagreement between the Engineer-in-charge and Contractor(s) on the test results, an independent expert shall be appointed by the Employer to whom both parties shall agree. If no amicable settlement can be reached, the Adjudication Clause shall be applied.

The procedure of inspections and tests at site, notice to the Engineer-in-charge, reports, commissioning, trial runs and trial operation, and acceptance tests shall be as per General Conditions of the Contract.

9.3.1 Commissioning and Trial Run

Immediately upon termination of commissioning of a part or section of the Permanent Works, which can operate as an independent unit a “Certificate of Suitability for Operation”, shall be issued by the Engineer.

This document shall be signed by an authorised representative of the Employer, the Engineer and the Contractor.

This Certificate shall state:

- The supplier of the Works concerned
- The quantity and type of Works concerned
- The conditions of commissioning
- The names of the participants
- The date of commencement of trial run
- The list of minor defects, if any, which has to be corrected by the Contractor

During the trial run the Contractor shall make familiar the Employer's personnel with the equipment, the operation and maintenance of the Works and its auxiliaries to such an extent that, thereafter, the duties can be assigned to the Employer's trained personnel. For achieving this, 20 to 24 authorised operation & maintenance persons of the Employer shall be trained in operation and maintenance for at least 30 days of trial run, prior to handing-over.

If any defects or irregularities affecting the safety or reliability of the Works should arise during the trial run, the trial run shall be interrupted and started again after such defects or irregularities have been corrected by the Contractor.

9.3.2 Acceptance

The taking-over testing of any part or section of the Permanent Works which can operate as an independent unit, shall be performed in accordance with the standards and regulations laid down in the " General Conditions of contract, and as per the test procedure agreed upon between Engineer-in-charge and Contractor.

Immediately upon termination of any such testing of a part or section of the permanent Works a "Protocol of Acceptance" which shall be deemed to be the Test Certificate required by General Conditions of Contract shall be issued by the Engineer-in-charge.

This document shall be signed by an authorised representative of the Employer, the Engineer-in-charge and the Contractor and shall form an integral part of the later "Taking-Over Certificate".

This "Protocol of Acceptance" shall state:

- The date of testing
- The quantity and type of Works concerned
- Statement of all minor defects and/or irregularities, which have to be corrected by the Contractor
- Confirmation that the guaranteed data have been proven
- Confirmation that all contractual documents have been submitted
- Confirmation that the Employer's personnel have been familiarised with the Works and that they will be able to operate and maintain the Works.

If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the Contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.

However, the tested part or section of permanent work shall continue to be operated by the Contractor, with the help of Employer's personnel, all the generating units have been tested and commissioned and trial run period of 15 days or that to be agreed with the Owner and the Contractor, has been completed in respect of last unit to be commissioned.

NOTE:

A part or section of the permanent works shall, for the purpose of this contract, mean one generating unit with all its units and station auxiliaries required to operate the unit at its rated load.

9.4 QUALITY ASSURANCE PLAN & INSPECTION SCHEDULES:

9.4.1 Quality Assurance Plan

The Contractor shall submit the detailed Quality Assurance Plan for the complete equipment/materials along with the bid for approval and acceptance by the Employer. This shall form integral part of the contract. The QAP shall include inspection and tests proposed to be conducted on raw material/bought out items at the time of induction in the process of manufacturing and at final stage of assembly.

9.4.2 ISO CERTIFICATION

The Contractor should have ISO–9000 Series certification. In case the Contractor does not posses ISO-9000 series certification, he shall submit following details along with the bid, for assessment of his capacity to supply quality equipment/materials/services under the contract.

- Contractor's quality system details:
- Details of system for dealing with items not conforming to prescribed specification.

- Details of sub vendor analysis procedure
- Details of stage and final inspection and auditing
- Contractor's system for calibration of testing and measuring equipment.
- Details of testing and measuring equipment available with contractor
- Details of important facilities/equipment available with the Contractor to produce reliable products having requisite standard.
- Qualification and experience of contractor's key QA personnel.

9.4.3 Inspection Schedules

To facilitate the Employer in planning its inspection activities, the Contractor shall submit along with the bid, the details of the lots along with the time schedule in which the ordered materials shall be offered for inspection as also the places of inspection. These details shall be finalized and approved and form an integral part of the Contract.

ANNEXURE - I

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
A	Internal surfaces of steel linings, penstock, turbine spiral casing, valves and other wetted internal ferrous surfaces		Intermediate Coat: 2 x micaceous iron oxide paint, 2-component Base: epoxy resin	2 x 100	This paint system is for temperatures up to 120^{O}C
			Finish Coat : 1 x topcoat, 2-component Base : epoxy resin	1 x 100	The colours of intermediate and finish coats shall be black - brown - black
			Total	300	

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
B	External surfaces of penstocks, Gantries, Cranes, Lifting Beams, Fixed Hoist supports and other Drive Supports	Sa 2 1/2 - 3	Prime Coat: 1 x zinc dust primer, 2-component Base: epoxy resin	1 x 50	The pure metallic zinc shall be at least 92% of the polymerized film
			Intermediate Coat: 2 x micaceous iron oxide paint,	2 x 80	This paint system is for temperatures up to 60^{O}C

			2-component Base : epoxy resin		
			Finish Coat : 1 x micaceous iron oxide paint, HB epoxy or PU paint coloured, 2-component Base : epoxy resin	1 x 80	
			Total	290	

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
C	External surfaces of indoor ferrous parts such as valves, connection pipes, oil carrying tanks and pipes, supporting structures, gantries, etc.	Sa 2 1/2 - 3	Prime coat : 1 x zinc dust primer, 2-component Base: epoxy resin	1 x 50	The pure metallic zinc shall be at least 92% of the polymerized film
			Intermediate Coat: 2 x micaceous iron oxide paint, 2-component Base : epoxy resin	2 x 80	This paint system is for temperatures up to 120°C

			Finish Coat : 1 x topcoat, 2-component Base : epoxy resin	1 x 50	
			Total	260	

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
D	Control cabinets, panels, cubicles, electric motors.	Sa 3 and de-grease before painting	Prime Coat: 2 x zinc chromate primer, 2-component Base: epoxy resin	2 x 40	
			Finish Coat : 2 x topcoat, 2-component Base : epoxy resin	2 x 50	
			Total	180	

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in m	Remarks
E	Interior surfaces of oil tanks	Sa 2 1/2 - 3	2 x thixo trop consistent paint Base :	2 x 220	

			epoxy resin		
			Total	440	

PAINTING SYSTEM					
Type	Description	Surface Preparation	Paint System	Main Dry Film Thickness in μm	Remarks
F	Frames, cover plates, pipes and tubes, and miscellaneous steel parts not especially mentioned	Hot-dip-galvanised as specified in Section 4.12.8.3 and de-grease before painting	Intermediate Coat : 1 x micaceous iron oxide paint, 2-components Base : epoxy resin	1 x 80	All the parts inaccessible for painting shall be only hot-dip galvanised
			Finish Coat 1 x topcoat, 2-component Base: epoxy resin	1 x 50	
			Total, incl. zinc	200	

ANNEXURE- 2

SYMBOLS AND ABBREVIATIONS

1. Length, area and volume

µm	micron = m. 10^{-6}
mm	millimeter
cm	centimeter
m	meter
km	kilometer
mm^2	square millimeter
cm^2	square centimeter
m^2	square meter
km^2	square kilometer
ha	hectare
m^3	cubic meter
l	litre
rad	radian

2. Time and time derived units

s	second
min	minute
h	hour
d	day
hr	hour
yr	year
mm/s	millimeters per second
m/s	meters per second
km/h	kilometers per hour

m/s^2	meters per second squared (acceleration)
m^3/s	cubic meters per second
Hz	hertz (periods per second)

3. Mass, force and derived units

kg	kilogram
g	gram = kg · 10^{-3}
mg	milligram = kg · 10^{-6}
mg/l	milligrams per liter
t	tonne = kg · 10^3
kg/m^3	kilograms per cubic meter
t/m^3	ton per cubic meter
N	Newton
N/m^2	Newton per square meter
N/mm^2	Newton per square millimeter
bar	bar = N/m^2 · 10^5
Pa	Pascal = $1N/m^2$
MPa	mega Pascal = Pa · 10^6
atm	standard atmosphere = 101325 Pa
J	Joule = 1 Nm (Newton-meter)
KJ	kilo joule = J · 10^3

4. Electrical units

A	ampere
V	volt
kVA	kilovolt ampere
kWh	kilowatt hour
W	watt = 1 J/s
kW	kilowatt = $W \cdot 10^3$
MW	megawatt = $W \cdot 10^6$
A.C.	Alternating current
D.C.	Direct current
HV	high voltage (cables)
LV	low voltage
MV	medium voltage

5. Other symbols and abbreviations

approx.	Approximately
bhp	brake horse power
CIF	cost, insurance and freight
dia. or diam.	Diameter
fig.	Figure
hp	horsepower
horiz.	Horizontal
HT	high tensile (steel)
Max.	Maximum
Min.	Minimum

No.	Number (units) e.g. 6 no.
No.	Number (order)as in No. 6
temp.	Temperature
°C	degrees Celsius
vert.	Vertical
vol.	Volume
wt	weight
%	per cent
M.F.L	maximum flood level
H.W.L	high water level
M.O.L.	Minimum operation level
IEC	International Electro-technical Commission
ISO	International Standards Organisation

SECTION 4

GUARANTEED TECHNICAL PARTICULARS

	Circuit breakers		
		UOM	Bidder Data
1	Make	-	**-**
2	Place of manufacturer	-	**-**
3	Class and Type	-	**-**
4	No. of poles	No.	**-**
5	a) Rated continuous current	A	**-**
	b) Rated short time withstand current	kA peak	**-**
7	Dry one min. power frequency withstand test voltage for the complete circuit breaker		**-**
	(a) between line terminal & ground	KV(rms)	**-**
	(b) between terminals with breaker contacts open	KV(rms)	**-**
8	1.2/50 micro sec. full wave impulse withstand voltage for the complete circuit breaker		**-**
	(a)between line terminal & ground	KV(rms)	**-**
	(b)between terminals with breaker contacts open	KV(rms)	**-**
9	Total creepage distance	mm	**-**
10	Minimum clearance in air		**-**
	(a) live parts to earth	mm	**-**
	(b)between phases	mm	**-**
	(c) live parts to ground level	mm	**-**
11	center to center distance between the adjacent phase unit of the breaker	mm	**-**
12	Rated symmetrical short-circuit breaking current	kA rms	**-**

13	Rated asymmetrical short-circuit breaking current	kA rms	**-**
14	Rated short-circuit making current	kA peak	**-**
15	Small inductive current breaking capability (without producing excessive over voltages)		
16	Number of quenching chambers	-	**-**
17	Mechanical opening time	ms	**-**
18	Total breaking time	ms	**-**
19	Total closing time	ms	**-**

Bidder's Stamp & Signature

ANNEXURE – A

SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Section/ Page No.	Clause No.	Deviation	Reason / Justification

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Tenderer's Stamp & Signature

CHECK LIST

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 5 NO + 5 NC spare contacts of each phase/ pole exclusively for purchaser's use and shall be wired up to common marshalling box of 132kV CB.	Confirmed	Yes/No
3.2	TB's for (for incoming AC Power Cables) shall be suitable for size 4Cx16 Sqmm Al (minimum).	Confirmed	Yes/No
3.3	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 and Enclosed with bid	Yes/No
5	**GTP**		
5.1	All equipment being supplied shall conform to Gurantee Technical Particulars as per technical specification and applicable IS / IEC	Confirmed	Yes/No
6	**TYPE TESTS REQUIREMENTS**		
6.1	All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.	Confirmed	Yes/No
6.2	In case the test reports are not found technically valid# during contract stage by BHEL/Customer, the bidder shall repeat these test(s) <u>at no extra cost to the purchaser and no delivery implication</u>. **Technical valid#** - Any error or incompleteness (any/all additional type tests not carried out) or discrepancy in the test reports vis-a-vis offered equipment due to any design / manufacturing changes (including substitution of components) or non-compliance with the requirement stipulated in the Technical Specification.	Confirmed	Yes/No

Date:

Bidder's Stamp & Signature

Contact Details: