

TENDER SPECIFICATION

BHEL: PSSR: SCT: 1454

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT Electrical Package of Unit- 1&2, Supply & Applications of touch-up, preservation and final painting of above package of NCTPS Stage-II 2x600 MW

at

North Chennai Thermal Power Station,

Atthipattu,

Chennai – 120, Tamil Nadu.

VOLUME –I BOOK - I

TECHNOCOMMERCIAL BID (Book I & II)

Book-I consists of

- o Notice Inviting Tender,
- o Volume-IA : Technical Conditions of Contract

Book-II consists of

- o Volume-IB : Special conditions of Contract,
- o Volume-IC : General conditions of Contract
- o Volume-ID : Forms & Procedures



BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)

Power Sector – Southern Region

690, Anna Salai, Nandanam, Chennai – 600 035.

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector, Southern Region
690, Anna Salai, Nandanam, Chennai – 35

Tender Specification No. BHEL: PSSR: SCT: 1454

for

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT Electrical Package of Unit- 1&2, Supply & Applications of touch-up, preservation and final painting of above package of NCTPS Stage-II 2x600 MW at North Chennai Thermal Power Station, Atthipattu, Chennai – 120, Tamil Nadu.

One set of Tender documents consisting of

- 1) TECHNOCOMMERCIAL BID - 2 copies
- 2) PRICE BID - 2 copies

Book Sl no

Issued to
M/s

Refer NIT for Last date of submission

Please note this tender document is not transferable

For and on behalf of
BHARAT HEAVY ELECTRICALS LIMITED

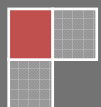
ADDL GENERAL MANAGER / CONTRACTS

Place: Chennai -35
Date:

Rev 00
6th July
2010

NOTICE INVITING TENDER

Bharat Heavy Electricals Limited



NOTICE INVITING TENDER (NIT)

**NOTE: BIDDER MAY DOWNLOAD FROM WEB SITES
OR
PURCHASE TENDERS FROM THIS OFFICE ALSO**

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To

Dear Sir/Madam

Sub : NOTICE INVITING TENDER

Sealed offers in two part bid system are invited from reputed & experienced bidders (meeting [PRE QUALIFICATION CRITERIA](#) as mentioned in Annexure-I) for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

Sl. No	ISSUE	DESCRIPTION
i	TENDER NUMBER	BHEL PSSR SCT 1454
ii	Broad Scope of job	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT Electrical Package of Unit- 1&2, Supply & Applications of touch-up, preservation and final painting of above package at North Chennai Thermal Power Station, Stage-II 2x600 MW Atthipattu, Chennai – 120, TamilNadu.
iii	DETAILS OF TENDER DOCUMENT	
a	Volume-IA	<i>Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc</i> <i>Applicable</i>
b	Volume-IB	<i>Special Conditions of Contract (SCC)</i> <i>Applicable</i>
c	Volume-IC	<i>General Conditions of Contract (GCC)</i> <i>Applicable</i>
d	Volume-ID	<i>Forms and Procedures</i> <i>Applicable</i>
e	Volume-II	<i>Price Schedule (Absolute value).</i> <i>Applicable</i>

iv	Issue of Tender Documents	1. <u>Sale from BHEL PSSR Regional office at :Chennai</u> Start : Mar 22, 2011 Closes: Apr 11, 2011 , Time :15.00 Hrs 2. From BHEL website (www.bhel.com) Tender documents can however be downloaded from website till due date of submission	Applicable
v	DUE DATE & TIME OF OFFER SUBMISSION	Date : Apr 12 , 2011, Time :15.00Hrs Place : <u>BHEL PSSR :Chennai</u> Tenders can be submitted through representative / in person at SCT Dept, BHEL PSSR, Chennai.	Applicable
vi	OPENING OF TENDER	Date : Apr 12, 2011, Time :16.00Hrs Notes: (1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time. (2) Bidder may depute representative to witness the opening of tender	Applicable
vii	EMD AMOUNT	Rs 2,00,000/- (Rupees Two Lakhs Only)	Applicable
viii	COST OF TENDER	Rs 2000/-.	Applicable
ix	LAST DATE FOR SEEKING CLARIFICATION	At least 7 days before the due date of offer submission or two days before the scheduled date of pre-bid meeting whichever is earlier Along with soft version also, addressing to undersigned & to others as per contact address given below	Applicable
x	SCHEDULE OF Pre Bid Discussion (PBD)	Date: Apr 01, 2011. Time 10.00AM at BHEL:PSSR:Chennai-35	Applicable
xi	INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)	Bidders shall enter into an Integrity Pact (IP) with BHEL as per format given at Volume 1D Formats of this tender. The bidders are required to return this Integrity Pact (IP) along with Techno Commercial Bid duly signed and stamped by the authorized signatory who signs the bid. It may be noted that only those bidders who have entered into such an IP with BHEL would be competent to participate against this tender i.e. entering into this pact is a preliminary qualifications for the bidders. The Independent External Monitor against this NIT shall be Shri ...	Not Applicable

xii	Latest updates	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to Tender Specifications will be hosted in BHEL webpage (www.bhel.com → Tender Notifications → View Corrigendums) and not in the newspapers. Bidders to keep themselves updated with all such information	
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- 2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly signed & stamped on each page, as part of offer. Rates / Price including discounts / rebates, if any, mentioned anywhere/in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.
- 3.0 Unless specifically stated otherwise, bidder shall remit cost of tender and courier charges if applicable, in the form of Demand Draft drawn in favour of Bharat Heavy Electricals Ltd, payable at Power Sector Regional HQ at Chennai issuing the Tender, along with techno-commercial offer. Bidder may also choose to deposit the Tender document cost by cash at the Cash Office as stated above against sl no iv of 1, on any working day; and in such case copy of Cash receipt is to be enclosed with the Techno Commercial offer. Sale of tender Documents shall not take place on National Holidays, holidays declared by Central or State Governments and BHEL PS HQ at Chennai, Sundays and second/ last Saturdays
- 4.0 Unless specifically stated otherwise, bidder shall deposit EMD through Demand Draft/Pay Order in favour of Bharat Heavy Electricals Ltd, payable at Chennai. For other details and for 'One Time EMD' please refer General Conditions of Contract.
- 5.0 Procedure for Submission of Tenders: The Tenderers must submit their Tenders to Officer inviting Tender, as detailed below:
- PART-I consisting of 'PART-I A (Techno Commercial Bid)' & 'PART-I B (EMD/COST of TENDER)' in two separate sealed and superscribed envelopes (ENVELOPE-I & ENVELOPE-II)
 - PART-II(Price Bid) – in sealed and superscribed envelope (ENVELOPE-III)
 - One set of each document shall be retained by the bidder for their reference.

6.0 The contents for ENVELOPES and the superscription for each sealed cover / Envelope are as given below. (All pages to be signed and stamped)

Sl no	Description	Remarks
	Part-I A	
	<u>ENVELOPE – I superscribed as :</u> PART-I (TECHNO COMMERCIAL BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: CONTAINING THE FOLLOWING:-	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	Duly filled-in 'No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. <u>Note:</u> a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be placed after document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding. (i) In case of acceptance of the deviations, appropriate loading shall be done by BHEL (ii) In case of unacceptable deviations, BHEL reserves the right to reject the tender.	
iii.	Supporting documents/ annexure/ schedules/ drawing etc as required in line with Pre-Qualification criteria. It shall be specifically noted that all documents as per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact ph no, FAX no, etc.	
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	If applicable
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification / NIT	
vii.	Notice inviting Tender (NIT)	

viii.	Volume – I A : <u>Technical</u> Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	
ix.	Volume – I B : Special Conditions of Contract (SCC)	
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	
xiii.	Any other details preferred by bidder with proper indexing.	

	PART-I B	
	ENVELOPE – II superscribed as: PART-I (EMD/COST of TENDER) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: CONTAINING THE FOLLOWING:-	
i.	1. Earnest Money Deposit (EMD) in the form as indicated in this Tender <u>OR</u> Documentary evidence for 'One Time EMD' with BHEL PSSR Chennai 2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)	

	PART-II	
	PRICE BID consisting of the following shall be enclosed	
	<u>ENVELOPE-III</u> superscribed as: PART-II (PRICE BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: CONTAINING THE FOLLOWING	
i	Covering letter/Offer forwarding letter of Tenderer enclosed in Part-I	
ii	Volume II – PRICE BID (Duly Filled in Schedule of Rates – rate / price to be entered in words as well as figures)	

	OUTER COVER	
	ENVELOPE-IV (MAIN ENVELOPE / OUTER ENVELOPE) superscribed as: TECHNO-COMMERCIAL BID, PRICE BID & EMD TENDER NO: NAME OF WORK: PROJECT: DUE DATE OF SUBMISSION: CONTAINING THE FOLLOWING:	
i	o Envelopes I o Envelopes II o Envelopes III	

SPECIAL NOTE: All documents / annexures submitted with the offer shall be properly annexed and placed in respective places of the offer as per enclosure list mentioned in the covering letter. BHEL shall not be responsible for any missing documents.

- 7.0 No Deviation with respect to tender clauses and no additional clauses/ suggestions/ in Techno-commercial bid/ Price bid shall normally be considered by BHEL. Bidders are requested to positively comply with the same.
- 8.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD).
- 9.0 **Assessment of Capacity of Bidders: (Shall be applicable for all Bid Evaluation from 1st April 2011)**
Bidders capacity for executing the job under tender shall be assessed as per the following:
- I. **Assigning Weightages (A) for Similar Jobs Under-Execution:** Weightages shall be worked out and assigned based on the average number of Similar Works under execution including works yet to be commenced by the agency, in the following manner:
 - i). **Number of Similar Jobs**
 - a) No. of jobs in BHEL, PSER : Say 'J'
 - b) No. of jobs in BHEL, PSSR : Say 'K'
 - c) No. of jobs in BHEL, PSWR : Say 'L'
 - d) No. of jobs in BHEL, PSNR : Say 'M'
 - e) No. of jobs with other customers* : Say 'N' (*: Other than BHEL PSER, PSSR, PSWR & PSNR)
 - f) Average No. of Jobs is 'P' = (J+K+L+M+N) divided by 5

- ii) Weightage “A” assigned to bidders based on Average Number of jobs “P”:
 a) If ‘P’ = 0-1, “A” will be equal to ‘3’
 b) If ‘P’ = 2-3, “A” will be equal to ‘2’
 c) If ‘P’ = 4-5, “A” will be equal to ‘1’
 d) If ‘P’ is Above 5, “A” will be equal to ‘0’

II. Weightage “B” for Quarterly Performance Reports of Vendors: This shall be based on the averages of the net weighted score obtained by the bidder for the jobs under execution (excluding works not commenced) for the quarter previous to the last quarter reckoned from the date of latest due date of submission, in all four Regions i.e BHEL PSER, PSSR, PSWR & PSNR, in the following manner.

i). Ratings by Power Sector Region:

- a) PS ER’s Rating ‘Rer’ = $(X_1 + X_2 + \dots + X_n)$
- b) PS WR’s Rating ‘Rwr’ = $(X_1 + X_2 + \dots + X_n)$
- c) PS SR’s Rating ‘Rsr’ = $(X_1 + X_2 + \dots + X_n)$
- d) PS NR’s Rating ‘Rnr’ = $(X_1 + X_2 + \dots + X_n)$
- e) Over all Power Sector Region Rating ‘R_{BHEL}’ = $(Rer + Rwr + Rsr + Rnr)$ divided by $(Ner + Nwr + Nsr + Nnr)$

(where “X₁, X₂, X₃,...X_n” is the net weighted score obtained by the bidder as per the “Evaluation of Contractor Performance (Quarterly)” against the various contracts ‘n’ under execution in the respective Region).

ii) Weightage “B” assigned to bidders based on Overall Power Sector Rating (R_{BHEL}):

- a) If R_{BHEL} is 80% and above, “B” will be equal to ‘6’
- b) If R_{BHEL} is > 70% < 80%, “B” will be equal to ‘5’
- c) If R_{BHEL} is > 60% < 70%, “B” will be equal to ‘4’
- d) If R_{BHEL} is = < 60%, “B” will be equal to ‘0’

III. Evaluation of Bidders capacity to execute the job under tender:

shall be based on the sum of scores obtained in ‘A’ and ‘B’, as below:

- a) 6 or above : Considered ‘Qualified’ for the job under tender
- b) Less than 6: Considered ‘NOT Qualified’ for the job under tender

IV. Explanatory note:

- a) Similar work means Boiler or Turbine or Civil or Electrical or CI, etc as detailed in the scope irrespective of rating of Plant.

- b) Quarter shall be as per the quarter defined in the “Evaluation of Contractor performance (Quarterly)”. For contracts where annexed Quarterly Evaluation performance was not part of the contract, ‘Quarterly Performance Reports’ previous to the last quarter reckoned from the date of latest due date of submission, given by the respective project site against the contract will be the basis for evaluation.
 - c) Vendors who are not executing any jobs presently in the Region and first timers to the Region, may be considered subject to satisfying all other tender conditions
 - d) ‘Under execution’ shall mean works in progress upto Boiler Steam Blowing (for Boiler and Auxilliaries) or Synchronisation (for all other jobs including Civil) shall be considered.
- 10.0 Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation etc before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above.
- 11.0 For any clarification on the tender document, the bidder may seek the same in writing or through e-mail, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.
- 12.0 BHEL may decide holding pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.
- 13.0 In the event of any conflict between requirement of any clause of this specification / documents / drawings / data sheets etc or requirements of different codes / standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages / other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting / submission of offer, else BHEL’s interpretation shall prevail.
- 14.0 Unless specifically mentioned otherwise, bidder’s quoted price shall deemed to be in compliance with tender including PBD.

- 15.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), if applicable, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (xi) of 1 above.
- 16.0 The Bidder has to satisfy the Pre Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of pre-qualification evaluation/ techno-commercial bids, approval/ acceptance of customer (as applicable), etc. and date of opening of price bids shall be intimated to only such bidders.
- 17.0 In case BHEL decides on a 'Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorised representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful/Disqualified bidders under intimation to the respective bidders.
- 18.0 Validity of the offer shall be for six months from the latest due date of offer submission (including extension, if any) or specified otherwise in SCC of tender.
- 19.0 BHEL reserves the right to decide the successful bidder on the basis of Reverse Auction process. In such case all qualified bidders will be intimated regarding procedure/ modality for Reverse Auction process prior to Reverse Auction and price will be decided as per the rules for Reverse Auction. .
- However, if reverse auction process is unsuccessful as defined in the RA rules/procedures, or for whatsoever reason, then the sealed 'PRICE BIDS' will be opened for deciding the successful bidder. BHEL's decision in this regard will be final and binding on bidder.
- 20.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.
- 21.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.
- 22.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.
- 23.0 In case Consortium Bidding is allowed as per Pre Qualifying Requirement, then Prime Bidder and Consortium Partner shall enter into Consortium Agreement. Validity period of Consortium Agreement shall be 6 months after which the same can be re validated.

'Stand alone' bidder cannot become a 'prime bidder' or a 'consortium bidder' in a consortium bidding. Prime bidder shall neither be a consortium partner to other prime bidder nor take any other consortium partners. However, consortium partner may enter into consortium agreement with other prime bidders. In case of non compliance, consortium bids of such Prime bidders will be rejected. .

24.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements" duly self certified and stamped by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

25.0 The bidder may have to produce original document for verification if so decided by BHEL.

26.0 Order of Precedence

In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

- a. Amendments/Clarifications/Corrigenda/Errata etc issued in respect of the tender documents by BHEL
- b. Notice Inviting Tender (NIT)
- c. Price Bid
- d. Technical Conditions of Contract (TCC)—Volume-1A
- e. Special Conditions of Contract (SCC) —Volume-1B
- f. General Conditions of Contract (GCC) —Volume-1C
- g. Forms and Procedures —Volume-1D

For BHARAT HEAVY ELECTRICALS LTD

AGM /SCT

Enclosure

01. Annexure-1: Pre Qualifying criteria.
02. Annexure-2: Check List.
- 03 Other Tender documents as per this NIT.

PRE QUALIFYING CRITERIA

JOB	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT Electrical Package as specified in the attached document of Unit- 1&2, Supply & Applications of touch-up, preservation and final painting of above package of NCTPS Stage-II 2x600 MW at North Chennai Thermal Power Station, Atthipattu, Chennai – 120, Tamil Nadu.
TENDER NO	BHEL PSSR SCT 1454

Sl. No	PRE QUALIFICATION CRITERIA	Bidders claim in respect of fulfilling the PQR Criteria	
		Name and Description of qualifying criteria	Page no of supporting document
A	Submission of Integrity Pact duly signed (if applicable)	Not applicable	
B	Assessment of Capacity of Bidder to execute the work as per sl no 9 of NIT (if applicable)	<u>Shall be applicable for Bid Evaluation from 1st April 2011</u>	
C	<u>Technical</u> The bidder should have executed Erection, testing and commissioning of HT / LT Electrical works consisting of HT Transformer of minimum rating of 90 MVA and other related Electricals like HT switchgears, HT Busducts, Cablings and Cable trays of minimum one unit rating of 190MW or above in any Power Plant (Utility / CPP- coal based or gas based) in the last seven years. The bidder should possess valid HT Electrical installation license. “Energisation of the respective equipment will be considered as completion of the works”.		
D 1	<u>Financial</u> TURNOVER Bidders must have achieved an average annual financial turnover (audited) of Rs 105 lakhs or more over last three financial years i.e., 2007-08, 2008-09 & 2009-10		

D2	NETWORTH Net worth of the bidder based on the latest audited accounts as furnished for 'D1' above should be positive.		
D3	PROFIT Bidders must have earned profit in any one of the three financial years in the last three years defined in 'D1' above		
E	Approval of Customer (if applicable) Note: Names of bidders who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval. Price bid of only those bidders shall be opened who are approved by customer.	Applicable	
F	Consortium criteria (if applicable)	Not applicable	
G	Notwithstanding the above, BHEL reserves the right to reject any or all the Tenders for reasons whatsoever beyond its control and the decision of BHEL is final.	Applicable	
	Explanatory Notes for QR 'A' 1. The word 'executed' means the bidder should have achieved the criteria specified in the QR even if the total contract has not been completed or closed 2. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as given above along with all annexures		

BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT (copies of Electrical license, Work order / LOI / LOA and work completion certificate) IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

CHECK LIST

1	Name and Address of the Tenderer		
2	Details about type of the Firm / Company		
3a	Details of Contact person for this Tender: Name : Mr / Ms Designation: Telephone No: Mobile No: Fax No: E-mail ID:		
3b	Details of alternate Contact person for this Tender: Name : Mr / Ms Designation: Telephone No: Mobile No: Fax No: E-mail ID:		
4	EMD DETAILS	DD No: _____ Date : _____ Bank : _____ Amount: _____ <u>Please tick (√) whichever applicable:-</u> ONE TIME EMD / ONLY FOR THIS TENDER	
5	Validity of offer	To be valid for six months from due date	
		APPLICABILITY	BIDDER REPLY
6	Whether the format for compliance with PRE QUALIFICATION CRITERIA is understood and filled with proper supporting documents referenced in the specified format	Applicable / Not applicable	YES / NO
7a	Audited profit and Loss Account for the last three years submitted	Applicable / Not applicable	YES/NO

7b	Audited profit and Loss Account of backup guarantor for the last three years submitted	Applicable / Not applicable	YES/NO
8	Copy of PAN Card submitted	Applicable / Not applicable	YES/NO
9	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable / Not applicable	YES/NO
10	Integrity Pact	Applicable / Not applicable	YES/NO
11	Declaration by Authorised Signatory	Applicable / Not applicable	YES/NO
12	No Deviation Certificate	Applicable / Not applicable	YES/NO
13	Declaration confirming knowledge about Site Conditions	Applicable / Not applicable	YES/NO
14	Declaration for relation in BHEL	Applicable / Not applicable	YES/NO
15	Non Disclosure Certificate	Applicable / Not applicable	YES/NO
16	Bank Account Details for E-Payment	Applicable / Not applicable	YES/NO
16	Capacity Evaluation of Bidder for current Tender	Applicable / Not applicable	YES/NO
17	Tie Ups / Consortium Agreement are submitted as per format	Applicable / Not applicable	YES/NO
18	Power of Attorney for Submission of Tender / Signing Contract Agreement	Applicable / Not applicable	YES/NO
19	Analysis of Unit rates	Applicable / Not applicable	YES/NO
20	Unquoted price bid submitted or not	Applicable / Not applicable	YES/NO

NOTE: STRIKE OFF 'YES' OR 'NO', AS APPLICABLE

Date:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Rev 00
6th July
2010

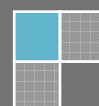
VOLUME – IA

Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

(Document No PS:MSX:TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART-I CHAPTER-I PROJECT INFORMATION

1. Project Name : North Chennai Thermal Power Station
2. Project Stage : Stage- II
3. No. of Units x Capacity : 2 X 600 MW
4. Project setting up by : Tamil Nadu Electricity Board (TNEB)
5. LOCATION AND APPROACH : (i) Athipattu Village
From Athipattu Railway Station about 6 Km.
From Chennai City about 20 Km.
From Chennai Airport 35 Km
(ii) District: Thiruvallur
(iii) State : Tamil Nadu
6. Nearest Railway Station : i) Athipattu Pudunagar on Chennai – Howrah route
8 KMs from site
ii) Athipattu 6 Km
7. Nearest Major Town & Distance : Chennai 20 Km.
8. Nearest Airport & Distance : Chennai 35 Km
9. Nearest Highway & Distance : All weather road from Pattamandri on
Chennai – Ponneri District Highway / 12 Kms.
10. Temperature: (Dry bulb) : Absolute Max. 45⁰ C(Highest mean monthly Max.35⁰ C)
: Absolute Min. 15⁰ C (Lowest mean monthly Min. 24⁰ C)
: Average 35⁰ C (Design)
11. Relative Humidity
Maximum : 100 %
Minimum : 36 %
Average : 75 % (Design)
12. Annual Rainfall : Max. 2540.8 mm / Average 1600 mm / Min 1175.7 mm.
13. Wind Load : Basic Wind Speed 50 mm/sec. (Max.) /
11.8 KMPH (Average)
14. Transport:
a) By Rail : Broad Gauge Railway line of Southern Railway
b) Road : District High way
15. Seismic Data : Zone – III as defined in IS: 1893 - 2002

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART – I CHAPTER – II SCOPE OF WORKS

1.2.0 SCOPE OF WORK IN GENERAL:

- 1.2.1 Scope of Electrical work covered in this tender are Transformers (all types), HT Switchgears (11/3.3) KV), HT Bus Ducts, Generator Control Panel) and commissioning of HT Drives, Start up control Panels
- 1.2.2 The scope of work covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, PVC sleeves for wire marking, lugs (specific sizes), specific type of fasteners, paints and its consumables. Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (except proprietary type instruments), returning of un-used materials / items to BHEL stores.
- 1.2.3 It is not the intent to specify herein all details of material. Any item related to this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.2.4 The scope of specification covers the installation, testing and commissioning of the following electrical equipments, hardware along with accessories as detailed in Bill of Materials
- 1.2.5 If any item or equipment not covered but requires to be erected / commissioned, the same shall be carried out by the contractor. Equivalent unit rate for those item or equipment shall be considered wherever possible from the BOM. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

Note:- Detailed BOM in systems wise and BHEL unit wise with detailed specification of various equipments and items are given in the VOLUME- IA PART-I CHAPTER-IX. The rate schedule is the summary of BOM i.e. consolidated list of BOM. Contractor shall go through the detailed BOM and specification before filling the rate in the rate schedule.

1.2.6 The scope of the work will comprise of but not limited to the following:

- 1.2.6.1 Receipt of materials / component to be erected by the contractor, loading and transportation from the storage yard to the project site, stacking, storage and preservation.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.2.6.2 Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.
- 1.2.6.3 Supply of consumables as per clause 1.3.6 & 1.2.2
- 1.2.6.4 Final painting including supply of paints.

Note:

FOR FURTHER DETAILED SCOPE OF WORKS REFER
RELEVANT CHAPTERS IN THIS BOOK

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART – I CHAPTER – III

CONSUMABLES & FACILITIES IN THE SCOPE OF CONTRACTOR / BHEL (SCOPE MATRIX) (SCOPE MATRIX)

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.1	ESTABLISHMENT			
1.3.1.1.1	FOR CONSTRUCTION PURPOSE:			
A	Open space for office	Yes		
B	Open space for storage	Yes		
C	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
D	Bidder's all office equipments, office / store / canteen consumables		Yes	
E	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
F	Fire fighting equipments like buckets, extinguishers etc		Yes	
G	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.3.1.1.2	FOR LIVING PURPOSES OF THE BIDDER			
A	Open space		Yes	
B	Living accommodation		Yes	
1.3.1.2	ELECTRICITY			
1.3.1.2.1	Electricity For construction purposes (to be specified whether chargeable or free)			
1.3.1.2.1.1	Single point source	Yes		Chargeable basis at the prevailing rate. Refer 1.3.4
1.3.1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	

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Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART I			
1.3.1.2.2	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	
1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4	Living facilities for office use including charges		Yes	
1.3.1.2.2.5	Demobilization of the facilities after completion of works		Yes	
1.3.1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines.(in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	
1.3.1.3	WATER SUPPLY			
1.3.1.3.1	For construction purposes:			
1.3.1.3.1.1	Making the water available at single point	Yes		Chargeable basis at the prevailing rate. Refer 1.3.5
1.3.1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.3.2	Water supply for bidder's office, stores, canteen etc			
1.3.1.3.2.1	Making the water available at single point		Yes	
1.3.1.3.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	

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Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.4	LIGHTING			
1.3.1.4.1	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5.0	COMMUNICATION FACILITIES for site operations of the bidder	-		
1.3.1.5.1	Telephone, Fax, internet, intranet, email etc		Yes	
1.3.1.6.0	COMPRESSED AIR SUPPLY			
1.3.1.6.1	Supply of Compressor and all other equipments required for compressor & compressed air system including pipes, valves, storage systems etc	-	YES	
1.3.1.6.2	Installation of above system and operation & maintenance of the same	-	YES	
1.3.1.6.3	Supply of the all the consumables for the above system during the contract period		YES	

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	ERECTION FACILITIES			
1.3.2.1	Engineering works for construction			
1.3.2.1.1	Providing the erection drawings for all the equipments covered under this scope	Yes		

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Sl.No	Description PART II	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2.1.2	Drawings for construction methods		Yes	In consultation with BHEL
1.3.2.1.3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	„
1.3.2.1.4	Shipping lists etc for reference and planning the activities	Yes	Yes	”
1.3.2.1.5	Preparation of site erection schedules and other input requirements		Yes	”
1.3.2.1.6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7	Weekly erection schedules based on SI No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily erection / work plan based on SI No 1.3. 2.1.7		Yes	For daily monitoring meeting at site
1.3.2.1.9	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
1.3.2.1.10	Preparation of preassembly bay		Yes	
1.3.2.1.11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor / bidder himself			Not applicable

1.3.3 OPEN SPACE:

Open space for building of temporary office shed and contractor's stores shed(s) will be provided free of charges. Contractor has to make his own arrangements for labour colony.

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1.3.4 ELECTRICITY:

- 1.3.4.1 Construction power will be provided to the contractor on chargeable basis at the applicable rate of TNEB under LT tariff V from the nearest substation. For construction purpose electricity will be provided at one single point by BHEL. The required energy meter for measuring power consumption will be provided and installed by BHEL. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. The present LT tariff V rate of TNEB is
- a) Consumption charges at Rs.5.80 per unit
 - b) Fixed charges at Rs. 30 per month
 - c) Electricity Tax on total amount at the rate of 5%
- The TNEB tariff may vary from time to time. Any dispute regarding consumption, the BHEL engineer decision is final
- 1.3.4.2 The required energy meter for measuring power consumption will be provided and installed by BHEL.
- 1.3.4.3 Necessary "Capacitor Banks" to improve the Power factor as stipulated by customer shall be provided by the contractor at his cost as per customer requirement. Penalty if any levied by customer on this account will be recovered from contractor's bills.
- 1.3.4.4 Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards contractor's office shed also all such expenditure shall be borne by the contractor.
- 1.3.4.5 Provision for distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.
- 1.3.4.6 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

1.3.5 WATER:

Water (Raw water) required for construction purposes including testing of Equipments will be provided on chargeable basis at applicable tariff of TNEB/Metro water from the nearest storage tank located inside the plant area. The required water meter for measuring the consumption will be provided by BHEL and the same shall be installed by the contractor. The required pumps & accessories, pipes for drawing water from the storage tank and further distribution will be arranged by the contractor at their cost.

The prevailing water charge is Rs 66.00 per 1000 litres which may vary from time to time as per TNEB/Metro water conditions. Any dispute regarding consumption, the

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BHEL engineer decision will be final. In case of non availability of water, the contractor shall make his own arrangements for uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make his own arrangements for his water requirement for Construction purpose and his labour colony at his cost.

1.3.6 MATERIALS / CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR FOR ERECTION AND COMMISSIONING AS PART OF THE SCOPE AT FREE OF COST

- i) All types of welding electrodes, filler wires, Gases
- ii) Provision for Temporary Scaffoldings.
- iii) Insulation tape.
- iv) Paints required for primer & final coating and for protective coating.
- v) Solder wire (Lead) -(60/40)
- vi) Protocol / Calibration report sheets as per BHEL Format.
- vii) Panel sealing compound material (for cable entry from bottom / top of Panel).
- viii) Materials required for cable dressing (GI / aluminum flats, PVC ties etc).
- ix) PVC wire marker sleeves and Tag plates
- x) Lugs of size 2.5 Sq.mm and below.
- xi) Anchor fasteners for wall mounted cable trays / JBs.

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VOLUME-IA PART – I CHAPTER – IV T&PS and MMEs TO BE DEPLOYED BY CONTRACTOR

The following minimum major Tools & Plants shall be deployed by the contractor for execution of this contract with in the quoted rate:

S no	Description	Capacity	Minimum quantity
1	5 to 6 kl/hr oil filtering machine and tank	5 to 6 kl/hr	01
2	1 to 1.5 kl/hr oil filtering machine and tank	1 to 1.5 kl/hr	01

EQUIPMENT FOR TESTING & COMMISSIONING :

The following testing equipment / T&P shall be brought to site by contractor in sufficient number to carry out the job simultaneously in more than one area.

- i) Insulation tester :
 - a) Motorised megger - 0 - 1000 - 2000 - 5000V, 0 - 25000 M ohms
 - b) Hand operated megger - 0.5 KV/1.0 KV/2.5 KV, 200 - 100 M ohm
- ii) Earth resistance tester 0 to 1, 10, 100 ohms
- iii) Transformer oil test kit
- iv) Torque wrench
- v) Voltmeter ac 0 - 125 - 250 - 625 V ac
- vi) Ammeter ac 0 - 2A - 10A ac.
- vii) Wattmeter - ac/dc - 0 - 125 - 250 V 0-5-10A.
- viii) Multimeter - analogue :acV 2.5V - 2500V, ac A - 100 mA - 10 A
dc V 25.V - 2500V, dc A - 50mA - 10A
Resistance - 0 - 200 M ohms
digital : voltages ac & dc - 100mv - 1000 V
current 10-mA - 10A Resistance - 0-20 M ohms
- ix) High vacuum stream line oil filter of 5000 to 6000 KL/hr (2 no) and 1000 LPH for transformer dryout.
- x) Variac - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.
- xi) Primary injection kit - 0-10000 A.
- xii) Secondary injection kit - 0-5A.
- xiii) HV Test kit - 50 KV AC 400kVA.
- xiv) Wheat stone bridge - 0.05 m ohm - 100 ohm.
- xv) Oscilloscope
- xvi) Air compressor.
- xvii) Oil Tank for transformer oil filtration

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- xviii) Vacuum pump.
- xix) Phase sequence meter - 110V - 450V - 25 to 65Hz.
- xx) Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.
- xxi) Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.
- xxii) Tachometer etc.
- xxiii) SF6 filling and evacuating equipment.
- xxiv) mA Source
- xxv) Standard pressure gauges
- xxvi) Temperature oil bath
- xxvii) Tan Delta Test kit
- xxviii) Oil specific gravity and PPM measuring equipment
- xxix) Dew point measurement instrument
- xxx) 3 phase relay testing kit (Of type omicron etc)

ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
1	Power Pack	0 to 50V DC, 3A	$\pm 2\%$
2	Analog Multimeter	Voltage 2.5 to 2500V AC	$\pm 1.0\%$
		Current 100 mA to 10A AC	$\pm 2.0\%$
		Current 250 micro A to 1A DC	$\pm 1.5\%$
		Resistance upto 100 ohms	$\pm 3.0\%$
		Voltage 2.5V to 2500V DC	$\pm 1\%$
3	Digital Multimeter	Voltage 200mV to 1000 V DC	$\pm 1\% + 1 \text{ digit}$
		Philips Voltage 200mV to 1000 V AC	$\pm 1\% + 1 \text{ digit}$
		Hcl Current 200mA to 20 A AC	$\pm 0.8\% + 1 \text{ digit}$
		Philips Current 20 mA to 20 A AC	$\pm 0.8\% + 1 \text{ digit}$
		Resistance (Hcl) 2120 200* to 200M*	$\pm 0.5\% + 1 \text{ digit}$
		Resistance (Hcl) 2105 200* to 200M*	$\pm 0.25\% + 1 \text{ digit}$
		Hcl Voltage 200mA to 750 V	$\pm 0.8\% + 1 \text{ digit}$
		Philips Current 20 mA to 20 A DC	$\pm 0.5\% + 1 \text{ digit}$
		Hcl Current 200 mA to 010 A AC	$\pm 1\% + 1 \text{ digit}$
4	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	$\pm 0.5\% \text{ mm/sec}$
		Displacement upto 300 microns	$\pm 2 \text{ microns}$
5	Secondary Injection Kit	Upto 5A	$\pm 0.5\text{mA}$
6	Motor operated Megger	Upto 200 Ohms	$\pm 5\%$ at Centre scale

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Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
7	Tongue tester	0/300/600A AC	+ 5%
		0 to 300A DC	+ 5%
8	Tachometer (Hand held)	0 to 4000 rpm	± 5%
9	Phase Sequence Meter		N/A
10	Three Phase Variac	15 A Capacity	N/A
11	Feeler gauges	300 mm long and 100 mm long	+ 2 microns
12	Dial gauges	0 to 10mm	+ 0.01 mm
13	Hand operated Megger 500V / 1000V	Upto 200 M Ohms	+ 5% at Centre Scale + 10% at end of Scale
14	Motorised Megger 2.5 KV	Upto 1000 M Ohms	+ 5% at Centre Scale + 10% at end of Scale
15	Earth Resistance tester (Tester)	0 to 1, 10, 100 Ohms	+ 5% at Centre Scale range
16	AC tongue Tester	0 to 300A AC	+ 3%
17	DC Tongue Tester	0 to 300A DC	+ 5%
18	High Voltage test Kit	Upto 50 KV AC	+ 10%
		Upto 70 KV DC	+ 10%
19	Tacho Generator (Mech)	0 to 4000 rpm	± 0.25%
20	DC Ammeter	0 to 300 A	+ 10%
21	DC Voltmeter	0 to 500 V	+ 10%
22	Micro ohm meter	10V and 100 V	
23	Primary Injection Kit	0-10000A	
24	Single Phase Variac	0-15 Amps	
25	Motor direction tester		
26	DC Tong Tester (mA)	0-500 mA	
27	Contact resistance tester for breaker contact resistance measurement		
28	Motorised Megger 5 KV	10000 M ohms	

1. Note for Contractors' Instruments

- a. For loading and transportation, all necessary T&P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor.

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- b. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.

2. Note for Contractors' Instruments

- a. The contractor shall arrange all the above. T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.
- b. The contractor at his cost shall arrange all cranes and truck / tractor, trailers required for material handling purpose and also cranes required for erection. If contractor requires any equipments other than what is mentioned as free issues from BHEL same can be hired from BHEL on chargeable basis subject to availability.
- c. Any other tools and plants instruments and equipment required in addition to the above for the successful completion of this job will have to be arranged by the contractor at his cost.
- d. Necessary accessories for the above shall also be provided by the contractor.
- e. The above instruments / equipment will be sent for testing and calibration wherever from time to time and maintained by contractor as required by BHEL.
- f. All testing instruments shall have calibration certificate issued by recognized / accredited agencies.
- g. List of such agencies and periodicity of calibration required for different instruments will be furnished by BHEL at site.
- h. Contractor shall maintain calibration records as per the BHEL format and produce them whenever called for by BHEL Engineers.
- i. Contractors shall arrange experienced/qualified persons for using these calibration instruments at laboratory and also at work spot.
- j. Wherever frequent calibration is required, contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.

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VOLUME-IA PART – I CHAPTER - V

T&Ps AND MMES TO BE DEPLOYED BY BHEL ON SHARING BASIS

List of T&Ps to be made available by BHEL to contractor free of hire charges on sharable basis.

S. No	Description	Quantity
01	Crane- 18T / 75 T capacity	01 No
02	5 kl / hr or above oil filtering machine and tank	01 No

Note:

- BHEL's 5 to 6 kl / hr oil filtering machine and tank will be available to contractor only after the contractor deploys the minimum T& Ps mentioned in SI no 1 & 2 of the table in Part I Chapter IV.
- BHEL will provide 75 / 18 Ton capacity cranes as mentioned in clause no. 1.13.1.2.18, 1.13.3.5 (v), on sharing basis at free of cost.
- BHEL will provide 18 Ton capacity cranes as mentioned in clause no. 1.13.3.6 (19f) on sharing basis at free of cost.
- BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL. Operator for the BHEL cranes excluding EOT crane will be provided by BHEL on free of charges.
 - In the event of providing BHEL Cranes:
Fuel has to be arranged by the bidder at their cost
 - In the event of providing hired cranes:
The fuel charges shall be recovered as given below:
 - For 75 T crane: Rs. 120/hr
 - For 150 T/ 135 T/100T crane: Rs 200 /hr
- EOT crane shall be provided by BHEL on free of hire charges as mentioned in clause no. 1.13.2.3 (ix), 1.13.3.6 (19f) and 1.13.2.3 Note 2. However Operator shall be arranged by the contractor. Electricity is chargeable as per clause no. 1.3.4.
- Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipments, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.

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7. All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at his cost.
8. Cranes are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.
9. The availability of cranes are likely to be hampered from time to time due to routine preventive maintenance or breakdown maintenance. Contractor has to make alternative arrangement or plan / modify / alter his activities to suit the above conditions and the contractor will not be liable for any compensation or extension of time due to this non availability, for maintaining the erection schedule.

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VOLUME-IA PART – I CHAPTER-VI TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1 The entire work of erection testing and commissioning of all electrical components including Supply & Application of Final Painting, as detailed in the Tender Specification shall be completed within 12 (twelve) months from the date of commencement of work at site.

1.6.1.2 During the total period of contract, the contractor has to carryout the activities in a phased manner as required by BHEL and the program of milestone events.

1.6.1.3 The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when the unit is in operation. The decision of BHEL in this regard shall be final and binding of the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy the decision of BHEL engineer is final.

1.6.3 MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING ETC.,

The activities for erection, testing etc shall be started as per directions of Construction manager of BHEL.

The contractor has to augment his resources in such a manner that following major milestones of erection & commission are achieved on specified schedules:

Major milestones for the units		
DESCRIPTION	MILESTONE MONTH	
	1 st Unit	2 nd Unit
Start of work (Expected)	1 st month (Apr-2011)	1 st month (Apr -2011)
Boiler Light Up	7 th month	5 th month
Barring gear	10 th month	10 th month
Synchronisation	10 th month	10 th month
Full load / Trial Operation	11 th month	11 th month
Handing over	11 th month	11 th month

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- 1.6.4 In order to meet above schedule in general, and any other intermediate targets set, to meet customer / project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.
- 1.6.5 In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitrable.
- 1.6.6 **CONTRACT PERIOD**
The contract period for completion of entire work under scope shall be 12 (Twelve) months from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier.
- 1.6.7 **GUARANTEE PERIOD FOR EACH UNIT**
The guarantee period of twelve months shall commence from the date of handing over of the Unit to Customer or six months from the date of first synchronisation of the set, whichever is earlier (Provided all erection, testing, and commissioning works are completed in all respects).

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VOLUME-IA PART – I CHAPTER-VII TERMS OF PAYMENT

1.7.0 Terms of payment :

The progressive payment for erection, testing and commissioning on accepted rate / price of contract value will be released as mentioned below in Cl 1.7.1 & 1.7.2.

1.7.1 Progressive Payment against monthly running bills will be made upto 85 % of the value of the erected items Pro rata as per Cl no 1.7.1.1 to 1.7.1.10.4 of the following table.

TERMS OF PAYMENT FOR HT ELECTRICAL WORKS		
Sl. No.	Activity / Work Description	% of unit rate
1.7.1	PRO RATA PAYMENTS (85%)	
1.7.1.1	Cable tray and accessories	
1.7.1.1.1	Fabrication and fixing / welding / bolting in position	60%
1.7.1.1.2	Earthing of cable trays	10%
1.7.1.1.3	Tagging of cable trays (including touch up painting & cable tray numbering on sides)	8%
1.7.1.1.4	Covering of trays where ever envisaged	7%
	Total =	85%
1.7.1.2	Cable laying including earthing wires	
1.7.1.2.1	Laying of cables / Wires	45%
1.7.1.2.2	Glanding and termination (except HT terminations)	15%
1.7.1.2.3	Testing and charging	10%
1.7.1.2.5	Dressing and clamping	15%
	Total =	85%
1.7.1.3	Junction box/Push button station (local)	
1.7.1.3.1	Erection including fixing of terminal blocks where ever applicable	75%
1.7.1.3.2	Name plate fixing where ever applicable and labelling (inside and outside)	10%
	Total =	85%
1.7.1.4	Misc. Structural steel including cable tray supports, Canopies etc, Conduits, pipes etc	
1.7.1.4.1	Fabrication / Pre assembly	45%
1.7.1.4.2	Erection, Alignment, welding/bolting and if applicable chipping/grouting/painting	40%
	Total =	85%

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1.7.1.5	DG sets / Switch Gears / MCC / PCC / Distribution Boards / Marshalling Box / Starter Units / Dry Transformers / Electrical Hoists/ Panels / Cubicles / Desks / UPS / Batteries / Chargers / VFD / LA assy / NGT / NGR / SP/ Miscellaneous Equipments/ etc	
1.7.1.5.1	Placement, Alignment and coupling / interconnection where ever applicable, erection of associated accessories etc	50%
1.7.1.5.2	Precommissioning checks and tests	10%
1.7.1.5.3	Charging, Loop testing and commissioning	15%
1.7.1.5.4	System commissioning	10%
	Total =	85%
1.7.1.6	Earthing / Lightning protection strips, Earthing pits	
1.7.1.6.1	Fabrication, erection, alignment, welding / bolting of earthing / lightning protection strips; earth pits Completion	60%
1.7.1.6.2	Testing/commissioning	25%
	Total =	85%
1.7.1.7	LT / HT Bus Ducts	
1.7.1.7.1	Pre assembly of Bus Ducts and accessories, erection, alignment, bolting/welding etc complete with supporting structure	50%
1.7.1.7.2	Pre commissioning checks	20%
1.7.1.7.3	Testing, Charging and Painting (as applicable)	15%
	Total =	85%
1.7.1.8	Oil Filled Transformers (Generator, Station, UAT, Standby etc)	
1.7.1.8.1	Placement on foundation and alignment	25%
1.7.1.8.2	Erection of associated auxiliaries / assemblies, oil filling, etc	25%
1.7.1.8.3	Dry out including oil filtration	15%
1.7.1.8.4	Precommissioning checks	10%
1.7.1.8.5	Testing, Charging and Painting (as applicable)	10%
	Total =	85%
1.7.1.9	Testing / Commissioning of Equipment (like motors, actuators, ESP transformer, misc equipments, etc) erected by other agencies	
1.7.1.9.1	Local testing (Including oil filtration for ESP transformers)	40%
1.7.1.9.2	Remote testing, Loop testing, and commissioning	40%
1.7.1.9.3	System commissioning	5%
	Total =	85%
1.7.1.10	Other items	
1.7.1.10.1	Rubber mats / Display Boards / Miscellaneous items / etc : on installation	85%
1.7.1.10.2	Specialised Commissioning Services - on pro rata basis.	85%
1.7.1.10.3	Civil Works / structural works - Prorata on completion of actual work.	85%
1.7.1.10.4	Termination, HT Termination, Straight through jointing etc : on pro rata basis	85%

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- 1.7.2 Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events (as per Cl no 1.7.2.1 to 1.7.2.11 of the following table) for the erected items.

1.7.2	STAGE / MILESTONE PAYMENTS (15%)	
1.7.2.1	On receipt of certificate from Electrical inspector for energising equipments (Full system)	1%
1.7.2.2	Boiler Light Up	1%
1.7.2.3	ABO	1%
1.7.2.4	Rolling and Synchronisation	2%
1.7.2.5	Coal Firing	1%
1.7.2.6	Full Load	2%
1.7.2.7	Trial Operation of Unit	3%
1.7.2.8	Punch List points / pending points liquidation	1%
1.7.2.9	Submission of 'As Built Drawings'	1%
1.7.2.10	Monthly Material Reconciliation	1%
1.7.2.11	Completion of Contractual Obligation	1%
	Total for Stage / Milestone Payments (15%)	15%

- 1.7.3 In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitrable.

Note:

1. Recovery of Retention amount as per Cl. 2.22 of GCC (Volume IC).
2. RA bill payments as per Chapter-X of SCC (Volume IB)
3. Payment for the first running bill will be released only on production of the following.
 - i. PF Regn. No.
 - ii. Labour License No.
 - iii. Workmen Insurance Policy No.
 - iv. Unqualified Acceptance for Detailed L.O.I.
 - v. Security Deposit as per GCC
 - vi. Rs 100 /- Stamp Paper for Preparation of Contract agreement.

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VOLUME-IA PART – I CHAPTER VIII TAXES AND OTHER DUTIES

1.8.0 TAXES

1.8.1 Value Added Tax (VAT) for the works

1.8.1.1 Price quoted shall be inclusive of VAT except service tax.

1.8.1.2 Notwithstanding the fact that this is only an erection service contract not involving any transfer of materials whatsoever and not attracting VAT liability, being labour oriented job work, for the purpose of VAT the contractor has to maintain the complete data relating to the expenditure incurred towards wages etc. in respect of the staff/workers employed for this work as also details of purchase of materials like consumables, spares etc., inter alia indicating the name of the supplier, address and VAT Registration No. and VAT paid for the purchases, etc

1.8.1.3 The bidder shall get registered with State VAT authorities and the registration certificate shall be forwarded to BHEL immediately after commencement of work. In case the bidder had already registered under respective State VAT, they must quote their registration Number and forward copy of Registration Certificate while submitting this tender.

1.8.1.4 The monthly/quarterly VAT return, duly incorporating the erection income from BHEL as turnover, should be submitted to BHEL at regular intervals with all annexure and details of payment of VAT (WCT).

1.8.1.5 You have to obtain VAT Clearance Certificate from the on concerned authorities as per the provisions of local VAT act, on completion of the project and submit along with the final bill.

1.8.1.6 The bidder shall quote very competitive price after taking into consideration of above points.

1.8.2.0 Service Tax

1.8.2.1. Price quoted shall be exclusive of Service Tax. The service tax as statutorily leviable and payable by the bidder under the provisions of service tax Law / Act shall be paid by BHEL as per bidder claim through various running bills. The bidder shall furnish proof of service tax registration with Central Excise Department specifying the name of services covered under this contract. Registration Certificate should also bear the endorsement for the premises from where the billing shall be done by the bidder on BHEL for this project. The bidder shall obtain prior consent of BHEL before billing the service tax amount.

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1.8.3.0 Other Taxes & Levies

- 1.8.3.1 Any other taxes and duties (except VAT & Service Tax) if any, as applicable, viz. Entry Tax, Octroi, Licenses, Deposits, Royalty, Stamp Duty, other charges / levies, etc. prevailing / applicable on the date of opening of technical bids and any variation thereof during the tenure of the contract are in the scope of bidder. In case BHEL is forced to pay any such taxes, BHEL shall have the right to recover the same from the bidder either from running bills or otherwise as deemed fit.

1.8.4.0 New Levies / Taxes

- 1.8.4.1 In case Government imposes any new levy / tax after award of the work during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract..

1.8.5.0 Statutory variations

- 1.8.5.1 Statutory variations are applicable only in the cases of Value Added Tax and Service Tax. The changes implemented by the Central / State Government in the VAT Act / Service Tax during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favour of BHEL. No other variations shall be allowed during the tenure of the contract.

1.8.6.0 Direct Tax

- 1.8.6.1 BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART – I CHAPTER - IX BILL OF MATERIALS

BILL OF MATERIALS FOR ERECTION, TESTING AND COMMISSIONING OF HT ELECTRICAL PACKAGE			
Bill of Materials (BOM) contains detailed specification of various instruments and items, BHEL Unit-wise and system-wise.			
Sl. No.	Description	Qty-unit 1	Qty-unit 2
A.0	BHEL BHOPAL SCOPE		
A.1.0	TRANSFORMER		
A.1.1	GENERATOR TRANSFORMER - 240 MVA 240 MVA, 420/√3/21 kV, 1 phase, OFAF cooled, Generator Transformer complete with loose accessories like 6 Nos. of coolers with fan, off circuit tap changers, HV/LV/HVN bushings, bushing CTs, Turrets, Conservator tank, Cooler control cabinet, Piping, Common kiosk, etc. Loose items like fascia windows, W.T.I. repeaters, buzzers, signal lamps, etc. shall be mounted and wired in control panel. Complete erection and integration of neutral formation (HV side only)for R, Y, B phases & grounding, including fixing of porcelain insulators and conductors (copper bars), brazing of joints, painting of supports, repair of damaged surface, protection at brazed areas of copper bar, connection to ground grid etc., shall also be part of transformer erection. Accessories: PRV-2 nos, Drain valve-2 nos, Cooler control cabinet, common kiosk, inlet valve-02 nos, & out let valve-1 no, 36kv post insulator-30 nos. Conservator: Main conservator tank with air cell, Buchholz relay, breather & connected pipe lines Cooling system: OFAF Cooler with fan – 6 nos, Headers , Pipe supports-4 nos, oil pump & motor -6 nos, OFI-6 nos, Valves. Turret and bushing : HV line & neutral bushing 01 each, LV bushing –2, HV&LV turret –1each, Neutral turret-1, on line DGA analyser-1each Off circuit tap switch –1set Approximate Dimensions of each transformer (l x b x h) Shipping dimensions 7250 x 3880 x 4800 mm Overall dimensions 13600 x 6200 x 11000 mm	4 sets*	3 sets*

TECHNICAL CONDITIONS OF CONTRACT (TCC)

	Weight of Transformer Components		
	Weight of Largest Package - 182000 Kg approx.		
	Weight of core and winding assembly-165000 Kg approx.		
	Weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers - 35500 Kg approx.		
	Total Oil - 47500 Kg approx.		
	Total weight of the Package - 248000 Kg approx.		
	Shipping weight - 182000 Kg approx.		
	Total Oil Quantity - 54500 Ltrs. approx.		
	<i>* Lump sum rate to be quoted including final painting</i>		
A.2.0	HT SWITCHGEAR		
A.2.1	11 KV Unit Switchboard - 1BA	1 set*	-
	11 KV, indoor, metal clad, vacuum break switchgears with 3150 A incomer-1 No, 1000A outgoing feeders - 2 nos, 630A outgoing feeders -24 Nos, 3150 A tie feeder- 1 No , Line PT and bus PT Cubicle- 1 No each, along with associated loose supplied items.		
	Incomer & Tie Panel Size -820(W)x2651(D)x2692(H)mm		
	Other Panel Size - 820(W)x1831(D)x2692(H) mm		
	Weight of Shipping section for 1 Panel: 1500 kg approx.		
	Weight of Shipping section for 2 Panels: 3000 kg approx.		
	<i>* Lump sum rate to be quoted.</i>		
A.2.2	11 KV Unit Switchboard - 2BA	-	1 set*
	11 KV, indoor, metal clad, vacuum break switchgears with 3150 A incomer-1 No, 1000A outgoing feeders - 2 nos, 630A outgoing feeders -24 Nos, 3150 A tie feeder- 1 No , Line PT and bus PT Cubicle- 1 No each, along with associated loose supplied items.		
	Incomer & Tie Panel Size- 820(W)x2651(D)x 2692(H)mm		
	Other Panel Size -820(W)x1831(D)x2692(H) mm		
	Weight of Shipping section for 1 Panel: 1500 kg approx.		
	Weight of Shipping section for 2 Panels: 3000 kg approx.		
	<i>* Lump sum rate to be quoted.</i>		
A.2.3	11KV Unit Switchboard - 1BB	1 set*	-
	11 KV, indoor, metal clad, vacuum break switchgears with 3150A incomer-1 No, 1000A outgoing feeder - 3 nos, 630A outgoing feeders -14 Nos, 3150 A tie feeder- 1No, Bus PT & Line PT Cubicle-1 No each, along with associated loose supplied items.		
	Incomer & Tie Panel Size -820(W)x2651(D)x2692(H)mm		

TECHNICAL CONDITIONS OF CONTRACT (TCC)

	Other Panel Size -820 (W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>		
A.2.4	11KV Unit Switchboard - 2BB 11 KV, indoor, metal clad, vacuum break switchgears with 3150A incomer-1 No, 1000A outgoing feeder - 3 nos, 630A outgoing feeders -14 Nos, 3150 A tie feeder-1No, Bus PT & Line PT Cubicle-1 No each , along with associated loose supplied items. Incomer & Tie Panel Size -820(W)x2651(D)x2692(H)mm Other Panel Size -820 (W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>	-	1 set*
A.2.5	Standby Switchboard 0BA, 11KV 11 KV, indoor, metal clad, vacuum break switchgears with 3150A incomer-1 No, 3150A tie feeders-4Nos, Line PT & bus PT Cubicle -1 No each and dummy panel - 2 Nos., along with associated loose supplied items. Incomer & Tie Panel Size -820(W)x2651(D)x2692(H) mm Other Panel Size -820(W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>	1 set*	-
A.2.6	3.3KV Unit auxillary Switchboard - 1CA 3.3 KV, indoor, metal clad, vacuum break switchgears with 3150A incomer-2 Nos, 630 A outgoing feeders -29 Nos, 3150A Bus coupler-1 No ,Bus PT Cubicle -2 Nos, Line PT cubicle - 2 Nos., along with associated loose supplied items. Incomer & Tie Panel Size- 820(W)x2651(D)x2692(H) mm Other Panel Size -820(W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>	1 set*	-
A.2.7	3.3KV Unit auxillary Switchboard - 2CA 3.3 KV, indoor, metal clad, vacuum break switchgears with 3150A incomer-2 Nos, 630 A outgoing feeders -29 Nos, 3150A Bus coupler-1 No ,Bus PT Cubicle -2 Nos, Line PT cubicle - 2 Nos., along with associated loose supplied items. Incomer & Tie Panel Size -820(W)x2651(D)x2692(H)mm	-	1 set*

TECHNICAL CONDITIONS OF CONTRACT (TCC)

	Other Panel Size -820(W)x1831(D)x2692(H) mm		
	Weight of Shipping section for 1 Panel: 1500 kg approx.		
	Weight of Shipping section for 2 Panels: 3000 kg approx.		
	<i>* Lump sum rate to be quoted.</i>		
A.2.8	3.3KV Plant water auxillary Switchboard OCA 3.3 KV, indoor, metal clad, vacuum break switchgears with 630A incomer-2 Nos, 630 A outgoing feeder-17 Nos, 630 A bus coupler-1 No, 630 A Line PT & bus PT Cubicle -2 Nos each, along with associated loose supplied items. Incomer Panel Size - 820(W)x2355(D)x 2692(H) mm Other Panel Size -820(W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>	1 set*	-
A.2.9	3.3KV AHP auxillary Switchboard OCB 3.3 KV, indoor, metal clad, vacuum break switchgears with 630A incomer-2 Nos, 630 A outgoing feeders -8 Nos, 630 A bus coupler -1 No, Bus PT Cubicle-2 Nos, Line PT cubicle - 2 nos, along with associated loose supplied items. Incomer Panel Size - 820(W)x2355(D)x 2692(H) mm Other Panel Size -820(W)x1831(D)x2692(H) mm Weight of Shipping section for 1 Panel: 1500 kg approx. Weight of Shipping section for 2 Panels: 3000 kg approx. <i>* Lump sum rate to be quoted.</i>	1 set*	-
A.3.0	GENERATOR , GT & UT CONTROL / PROTECTION & METERING PANELS		
A.3.1	Generator Relay Panel Generator Relay Panel with associated loose supplied items such as PC, Printer, UPS, interconnecting cables etc. No. of Panels: 4 Nos. supplied in suitable shipping sections. Size of each Panel: 1000 (w) x 1000 (d) x 2295 (h) mm Approximate weight of each panel : 500 kg <i>* Lump sum rate to be quoted.</i>	1 set*	1 set*
A.3.2	BUS TRANSFER PANEL Approximate dimensions : 1600(w) x 600(d)x2315(h) mm (Suit of two cubicles) Weight : 500 kg approx. <i>* Lump sum rate to be quoted.</i>	1 set*	1 set*

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A.4.0	Data Concentrator along with PC, Laptop, Printer & other accessories	1 set*	1 set*
	Panel -Approx. dimensions :800 (w)x1000(d)x2400(h)mm		
	Weight : 600 kg approx		
	<i>* Lump sum rate to be quoted.</i>		
A.5.0	EARTHING TRUCK / BREAKERS	12 nos.	06 nos.
	Approximate dimensions : 650(L) x 1363(H) mm		
	Weight : 300 kg approx		
B.0	BHEL JHANSI SCOPE		
B.1.0	TRANSFORMERS		
B.1.1	UNIT TRANSFORMER	2 sets*	2 sets*
	40/50 MVA, 21KV/11.5KV, ONAN/ ONAF, 3 Phase, Unit Transformer with HV/LV/LVN Porcelain bushings, Marshalling Box, Main conservator, Aux.conservator for OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators with Fans, On load tap changer on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , 11 KV NGR with supporting stand, etc.		
	<u>Approximate dimensions (LxBxH)</u>		
	Overall dimensions : 10000 x 6000 x 7000 mm		
	Shipping Dimension of Largest package:5200x3600x4000 mm		
	Weight of heaviest package- 48000 Kg approx.		
	Total weight- 88000 Kg approx.		
	Oil Qty- 34000 Ltrs. approx.		
	<i>* Lump sum rate to be quoted including final painting.</i>		
B.1.2	STANDBY TRANSFORMER	1 set*	-
	40/50 MVA, 230/11.5 KV, 3 Phase, ONAN/ONAF, Standby Transformer with OLTC on HV Side, Radiators with cooling fans, Main conservator, Aux. conservator for OLTC, A-frame supports, Marshalling box, piping, 11KV NGR with supporting stand, etc.		
	<u>Approximate dimensions (LxBxH)</u>		
	Overall dimensions : 12600 x 6700 x 7740 mm		
	Shipping Dimension of Largest package:6200x3100x4000 mm		
	Weight of heaviest package - 60000 Kg approx.		
	Total weight - 115000 Kg approx.		
	Oil Qty - 38000 Ltrs. approx.		
	<i>* Lump sum rate to be quoted including final painting.</i>		

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B.1.3	UNIT AUX. TRANSFOMER	2 sets*	2 sets*
	16 MVA, 11/3.5 KV, ONAN, 3 phase, Unit Aux. Transformer with off load tap changer on H.V Side, HV/LV/LVN Porcelain bushings, radiators, conservator, marshalling panel, HV Cable box with disconnecting chamber, Buchholz relay, Cable box supports, PRV, piping, 3.3KV NGR with supporting stand, etc.		
	<u>Approximate Dimensions</u> (l x b x h)		
	Overall dimensions : 7200 x 5500 x 5600 mm		
	Shipping dimension of Largest Package : 4600 x 2500 x 2900 mm		
	Oil - 9750 Kg approx.		
	Weight of heaviest package - 32000 Kg approx.		
	Total Weight - 39780 Kg. approx.		
	<i>* Lump sum rate to be quoted including final painting.</i>		
B.1.4	DRY TYPE TRANSFORMER	4 sets*	4 sets*
	2500 KVA, 11KV/433 V, AN, 3 Phase, Cast Resin Dry type Transformer, Off Circuit tapping on HV, HV bushings rated for 12 kV, HV Cable box , LV Non Segregated		
	Phase Bus duct connections, other accessories etc.		
	<u>Approximate dimensions</u>		
	Overall dimensions: 2800 x 2165 x 2750 mm		
	Total Shipping weight- 8000 Kg approx.		
	<i>* Lump sum rate to be quoted.</i>		
B.2.0	CONTROL PANEL		
B.2.1	TRANSFORMER REMOTE TAP CHANGER CONTROL PANEL	3 sets*	2 sets*
	Approximate dimensions :660(W) x 660(D) x 2295(H)mm		
	Weight : 500 kg approx		
	<i>* Lump sum rate to be quoted.</i>		
C.0	BHEL PEM SCOPE		
C.1.0	SERVICE TRANSFORMERS		
C.1.1	3500 KVA, 11KV/3.5KV, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with fittings and accessories.	4 sets*	-
	<u>Accessories Fitted with Transformers</u>		
	Marshalling box, Drain valve, Filter valve, HV cable box, LV side flange for busduct connection, OFF circuit tap switch, Sampling valve, Conservator shutoff valve etc		
	<u>Loose items :</u>		

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	3.3KV NGR with supporting stand, Conservator tank with magnetic oil level gauge, Silica gel breather with pipe, Conservator connecting pipe, Radiator-06 nos, Buchholz relay, PRV-02 nos, Gas collecting device with pipe and Remote winding temperature indicator-03 nos, etc. Approximate dimensions Overall dimensions : 3560(L)X2660(B) X3050(H) mm Shipping Dimension of Largest package : 3250(L)X2150(B)X2380(H) mm Weight of each Transformer Components Core and Winding - 3840 Kg approx. Tank & Fittings - 3060 Kg approx. Oil - 1400 Kg approx. Total weight - 8300 kg approx. Weight of heaviest package - 6200 Kg approx. <i>* Lump sum rate to be quoted including final painting.</i>		
C.1.2	2500 KVA, 11KV/433 V, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with fittings and accessories. Accessories Fitted with Transformers Marshalling box, Conservator tank with magnetic oil level gauge, Conservator connecting pipe, Buchholz relay, Drain valve, Filter valve, LV side flange for busduct connection, OFF circuit tap switch, Sampling valve, Conservator shutoff valve, etc. Loose items : HV cable box, Silicagel breather, Radiator-06 nos, PRV-02 nos, Gas collecting device with pipe and Remote winding temperature indicator-03 nos. etc Approximate dimensions Overall dimensions : 3470(L)X2870(B)X2760(H) mm Shipping Dimension of Largest package : 3300(L)X1980(B)X2530(H) mm Weight of each Transformer Components Core and Winding - 2950 Kg approx. Tank & Fittings - 2790 Kg approx. Oil - 1260 Kg approx. Total weight - 7000 Kg approx. Weight of heaviest package - 5130 Kg approx. <i>* Lump sum rate to be quoted including final painting.</i>	2 sets*	-

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C.1.3	2000 KVA, 11KV/433 V, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with fittings and accessories.	5 sets*	-
	Accessories Fitted with Transformers		
	Marshalling box, Conservator tank with magnetic oil level gauge, Conservator connecting pipe, Buchholz relay, Drain valve, Filter valve, LV side flange for busduct connection, OFF circuit tap switch, Sampling valve, Conservator shutoff valve, etc.		
	Loose items :		
	HV cable box, Silica gel breather, Radiator-06 nos, PRV-02 nos, Gas collecting device with pipe and Remote winding temperature indicator-03 nos. etc		
	Approximate dimensions		
	Overall dimensions : 3350(L)X2530(B)X2540(H) mm		
	Shipping Dimension of Largest package : 3180(L)X1950(B)X2410(H) mm		
	Weight of each Transformer Components		
	Core and Winding - 2180 Kg approx.		
	Tank & Fittings - 2170 Kg approx.		
	Oil - 1070 Kg approx.		
	Total weight - 5420 Kg approx.		
	Weight of heaviest package - 4090 Kg approx.		
	<i>* Lump sum rate to be quoted including final painting.</i>		
C.1.4	1600 KVA, 11KV/433 V, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with fittings and accessories.	14 sets*	8 sets*
	Accessories Fitted with Transformers		
	Marshalling box, Conservator tank with magnetic oil level gauge, Conservator connecting pipe, Buchholz relay, Drain valve, Filter valve, LV side flange for busduct connection, OFF circuit tap switch, Sampling valve, Conservator shutoff valve etc		
	Loose items :		
	HV cable box, Silica gel breather, Radiator-06 nos, PRV-02 nos, Gas collecting device with pipe and Remote winding temperature indicator-03 nos, etc.		
	Approximate dimensions		
	Overall dimensions : 3210(L)X2100(B)X2520(H) mm		
	Shipping Dimension of Largest package : 3040(L)X1880(B)X2390(H) mm		
	Weight of each Transformer Components		

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	Core and Winding - 2180 Kg approx.		
	Tank & Fittings - 1880 Kg approx.		
	Oil - 830 Kg approx.		
	Total weight - 4890 Kg approx.		
	Weight of heaviest package - 3930 Kg approx.		
	<i>* Lump sum rate to be quoted including final painting.</i>		
C.2.0	24KV GENERATOR CIRCUIT BREAKER		
	3 pole beam/floor mounted SF6 Generator Circuit Breaker with loose supplied mounting frames/ brackets, supports, individual pole breaker indication panels, centralizing panel, series isolators, Surge capacitors and short circuit connect link, earthing switch etc including all associated accessories	1 set*	1 set*
	Rated voltage - 24 KV		
	Rated continuous current - 21 kA		
	Rated frequency - 50 Hz		
	Cooling type - Forced cooling		
	Total weight of circuit breaker - 7210 Kg approx		
	Dimensions: 6719 mm x 3746 mm x 3457 mm		
	<i>* Lump sum rate to be quoted including final painting.</i>		
C.3.0	LAYING OF HT CABLES		
C.3.1	11KV/11KV (UE) grade Aluminium, XLPE insulated, armoured cables of the following sizes		
C.3.1.1	3C x 150 sq. mm	12600 Mtr.	8400 Mtr.
C.3.1.2	1C x 300 sq. mm	8400 Mtr.	5600 Mtr.
C.3.2	3.3KV/3.3KV (UE) grade Aluminium , XLPE insulated, armoured cables of the following sizes		
C.3.2.1	3C x 150 sq. mm	6000 Mtr.	4000 Mtr.
C.3.2.2	1C x 150 sq. mm	4800 Mtr.	3200 Mtr.
C.3.3	6.35KV/11KV (E) grade Aluminium , XLPE insulated, armoured cables of the following sizes		
C.3.3.1	3C x 300 sq. mm	1800 Mtr.	1200 Mtr.
C.3.4	6.35KV/11KV (E) grade Aluminium , XLPE insulated, unarmoured cables of the following sizes		
C.3.4.1	1C x 630 sq. mm	2700 Mtr.	1800 Mtr.
C.4.0	HT CABLE TERMINATION KITS/ JOINT KITS		
C.4.1	11KV/11KV (UE) Grade, Indoor type, XLPE insulated cable end termination kit		
C.4.1.1	3C x 150 Sq. mm, Armoured Al cable	53 nos.	53 nos.
C.4.1.2	1C x 300 Sq. mm, Armoured Al cable	79 nos.	78 nos.

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C.4.2	11KV/11KV (UE) Grade, Indoor type, XLPE insulated cable Straight Through Joining kit		
C.4.2.1	3C x 150 Sq.mm, Armoured Al cable	3 nos.	3 nos.
C.4.3	6.35KV/11KV (E) Grade, Indoor type, XLPE insulated cable end termination kit		
C.4.3.1	3Cx 300 Sq. mm, Armoured Al cable	34 nos.	34 nos.
C.4.3.2	1C x 630 Sq. mm, Un-Armoured Al cable	82 nos.	82 nos.
C.4.4	3.3KV/3.3KV (UE) Grade, Indoor type, XLPE insulated cable end termination kit		
C.4.4.1	1C x 150 Sq. mm, Armoured Al cable	64 nos.	64 nos.
C.4.4.2	3C x 150 Sq. mm, Armoured Al cable	55 nos.	55 nos.
C.4.5	3.3KV/3.3KV (UE) Grade, Indoor type, XLPE insulated cable Straight Through Joining kit		
C.4.5.1	3C x 150 Sq. mm, Armoured Al cable	3 nos.	3 nos.
D.0	BHEL RUDRAPUR SCOPE		
D.1.0	BUSDUCT :		
D.1.1	21 KV IP BUSDUCT	1 set*	1 set*
	21 KV IP Busduct along with support structures, SPVT cubicle, LAVT cubicle, NG cubicle and other loose supplied items such as Seal off bushings, CTs, Lightning arrestor, Air Pressurization equipment, control panel, flexible hoses from APE system unit to Bus Duct , Control cabinet for APE, Conduiting and wiring for space heaters, illumination, etc., CT/PT wiring and conduiting, erection of JB's etc. comprising of the following:		
	a) 21000 A IP Busduct from 600 MW Generator to generator transformers.		
	b) 12500 A Delta Run Busduct		
	c) Tap off Busducts 3000 A to 2x40/50 MVA Unit Transformers		
	Dimensions and Weights		
	a) Approx. Total BD length of all types : 406 Mtrs (Main,Delta,Tapoff,LAVT,NG)		
	b) Approx. Length of main busduct at Neutral side of all phases: 11 Mtrs		
	c) Shape and size of main bus bar: Cylindrical 16TKx800 O/D		
	d) Shape and size of Tap off bus bar: 2x203.2x65.02x11.84 channel(Box formation)		
	e) Shape and size of Delta bus bar: Cylindrical 15TKx530 O/D		

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	f) Approx. Weight of busduct (Main, Tap-off, Delta Connection) - 100MT		
	g) Shape and size of main busduct enclosure: Cylindrical 1600 O/D, 8 TK		
	h) Shape and size of Tap off busduct enclosure: Cylindrical 876 O/D, 4.78 TK		
	i) Shape and size of Delta busduct enclosure: Cylindrical 1070 O/D, 6.35 TK		
	j) AIR Pressurization equipment : size 4800x3750x2250 mm, weight 1 ton approx.		
	k) NG (NGR-NGT) Cubicle: 2200x1600x2135 mm, 1750 kg (approx.)		
	l) SPVT Cubicle: 3 Nos, each of size 800x2250x2835 mm and weight 1400 kg each		
	m) LAVT Cubicle: 3 Nos, each of size 800x2250x2085 mm and weight 1200 kg each		
	n) Weight of support Structure: 65 MT for each unit (approx.)		
	<i>* Lump sum rate to be quoted including final painting.</i>		
	11 KV SP Busducts		
D.2.0	The SP Busducts will be supplied along with support structures and other loose supplied items like Seal off Bushings, flexibles, Rubber bellows, etc. Work includes mounting of Breather, Conduiting and wiring for space heaters, erection of JB's, etc.		
D.2.1	11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-1BAT01 to 11KV Switchboard 1BA 11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-1BBT01 to 11KV Switchboard 1BB	110 Mtrs.	-
D.2.2	11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-2BAT01 to 11KV Switchboard 2BA 11KV, 3150 A, Segregated Phase Busduct from 50 MVA unit transformer-2BBT01 to 11KV 2BB Switchboard	-	230 Mtrs.
D.2.3	11KV, 3150A, Segregated Phase Busduct from 50MVA Standby TR. 0BAT01 to Stand By switch board 0BA	120 Mtrs.	-
D.2.4	11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 1BA 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 1BB 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 2BA	20 Mtrs.	60 Mtrs.

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	11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 2BB		
D.2.5	3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 1CAT01 to 3.3 KV Unit Board 1CA 3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 1CAT02 to 3.3 KV Unit Board 1CA	81 Mtrs.	-
D.2.6	3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 2CAT01 to 3.3 KV Unit Board 2CA 3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 2CAT02 to 3.3 KV Unit Board 2CA	-	84 Mtrs.
D.2.7	3.3 KV, 630A, Segregated Phase Busduct from 3.5 MVA Plant Water Aux. Transformer 0CAT01 to Plant Water Aux. switch board 0CA 3.3 KV, 630A, Segregated Phase Busduct from 3.5 MVA Plant Water Aux. Transformer 0CAT02 to Plant Water Aux. switch board 0CA 3.3 KV, 630A, Segregated Phase Busduct from 3.5 MVA AHP Aux. Transformer 0CBT01 to AHP Aux. Switchboard 0CB 3.3 KV, 630A, Segregated Phase Busduct from 3.5 MVA AHP Aux. Transformer 0CBT02 to AHP Aux. Switchboard 0CB	40 Mtrs.	-
	Approximate Total Weight of support structure for SP Busducts - 62 MT (For both unit)		
	Approximate Weight of BD : 90kg/mtr		
E.0	BHEL EDN SCOPE		
E.1.0	EXCITATION EQUIPMENTS		
E.1.1	DAVR Digital AVR consisting of 2 Nos. Regulation cubicles, 1 No. Thyristor cubicle, 1 No. Field suppression cubicle, along with associated loose supplied items. Overall dimension: 4031 x 800 x 2295 mm, Approximate wt : 3000 Kg. <i>* Lump sum rate to be quoted.</i>	1 set*	1 set*
E.1.2	TRANSFORMER CUBICLE Overall dimension: 1175 x 800 x 2295 mm, Approximate wt : 1000kg	1 No.	1 No.
E.2.0	VFD FOR ID FANS		
E.2.1	VFD Transformer	4 sets*	4 sets*

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	5000 KVA, 11/4.1 KV, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with fittings and accessories. Accessories Fitted with Transformers Marshalling box, HV/LV/LVN Bushings, Bottom Drain cum Filter valve, Top / Bottom oil sampling valve, Tap changing switch, PRV, etc. Loose items : HV/LV/LVN cable box with disconnecting chamber, Conservator tank with MOLG, Double float Buchholz relay with 02 nos. valves, Silica gel breather with pipe, P.S. Radiator-08 nos., Explosion vent, Remote WTI 01 no., etc. Approximate dimensions Overall dimensions : 4025(L)X3400(B)X3250(H) mm Shipping Dimension of Largest package : 3800(L)X2100(B)X2200(H) mm Weight of each Transformer Components Core and Coil - 5600 Kg approx. Oil - 2400 Kg approx. Oil Quantity - 2695 Ltrs approx. Total weight - 12100 Kg approx. Weight of heaviest package- 10285 Kg approx. <i>* Lump sum rate to be quoted including final painting.</i>		
E.3.0	VFD PANELS		
E.3.1	VFD Switchgear Panel 11 KV, indoor, metal clad, vacuum break switchgear panel with 1250A incomer & Bus PT along with associated loose supplied items. VFD Switch gear consists of 2 Panels in suitable shipping sections. Overall dimension: 1640(L) x 2355(D) x 2300(H) mm Weight of Shipping section for 2 Panel: 1350 Kg approx <i>* Lump sum rate to be quoted.</i>	4 sets*	4 sets*
E.3.2	LCI Drive Panel: Comprising Control and Excitation Panel, Fan and Filter Panel with air duct for exhausting air and Bridge Panel. Size: 6304(L) x 1450(D) x 2420(H) mm; Weight: 5500 Kg approx. <i>* Lump sum rate to be quoted.</i>	4 sets*	4 sets*

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E.3.3	CLC Panel (Cable Length Compensation Panel) Size: 850 x 1200 x 2500 mm; weight: 400 Kg approx.	4 sets	4 sets
E.3.4	Common Control Panel for VFD Drives, including PC System for MMI Size: 800 x 1450 x 2400 mm; weight: 400 Kg approx. <i>* Lump sum rate to be quoted.</i>	2 sets*	2 sets*
E.3.5	Air core DC link Reactor Floor/channel mounting type, 25 mH, 1000 A rated air cored DC reactor housed in 3mm thick Aluminium cubicle with suitable input/output terminals Dimension: 2700(L) x 2450(B) x 2325(H) mm , Weight: 2600 Kg approx.	4 sets.	4 sets.
E.4.0	LAYING OF LT POWER CABLES-1.1 KV Grade, Aluminium conductor, PVC insulated Armoured cable		
E.4.1	3C X 25 Sq.mm	5450Mtrs	5450 Mtrs
E.4.2	3C X 120 Sq.mm	700 Mtrs	700 Mtrs
E.5.0	TERMINATION OF LT POWER CABLES		
E.5.1	3C X 25 sq. mm, Al, Armoured	16 Nos.	16 Nos.
E.5.2	3 C X 120 sq. mm, Al, Armoured	6 Nos.	6 Nos.
E.6.0	LAYING AND TERMINATION OF OF LT POWER / CONTROL CABLES-1.1 KV Grade, Copper conductor, FRLS, PVC insulated Armoured cable		
E.6.1	2C X 2.5 Sq.mm	1150Mtrs	1150 Mtrs
E.6.2	2C X 1.5 Sq.mm	4500Mtrs	4500Mtrs
E.6.3	4C X 1.5 Sq.mm	425 Mtrs	425 Mtrs
E.6.4	14C X 1.5 Sq.mm	425 Mtrs	425 Mtrs
E.7.0	Laying and Termination of Individual Pair & Overall Shielded, Twisted Pair, Armoured cables		
E.7.1	2 Pair x 0.5 mm ²	2200Mtrs	2200 Mtrs
E.7.2	4 Pair x 0.5 mm ²	4300Mtrs	4300 Mtrs
E.7.3	12 Pair x 0.5 mm ²	1450Mtrs	1450 Mtrs
E.8.0	Laying and Termination of Overall Shielded, Twisted Pair, Armoured cables		
E.8.1	2 Pair x 0.5 mm ²	2200Mtrs	2200 Mtrs
E.8.2	4 Pair x 0.5 mm ²	3100Mtrs	3100 Mtrs
E.8.3	8 Pair x 0.5 mm ²	3200Mtrs	3200 Mtrs
E.8.4	12 Pair x 0.5 mm ²	1050Mtrs	1050 Mtrs

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F.0	COMMISSIONING OF THE FOLLOWING ERECTED BY MECHANICAL CONTRACTOR		
F.1.0	600 MW Generator	1 no.\$	1 no.\$
	H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of generator.		
F.2.0	HT Motors		
F.2.1	11 KV Motors	11 nos-\$	11 nos-\$
F.2.2	3.3 KV Motors	38 nos-\$	33 nos.\$
F.3.0	ESP Transformer	80 nos. \$	80 nos. \$
	Commissioning of High voltage rectifier transformer –95 KVp, 1000 mA Mineral oil HVR, Single Phase, 50 Hz, Silicon Diode Bridge Rectifier, approx. Oil capacity of 750 Ltrs.		
	The scope of work includes oil filtration, sample testing for dielectric strength, PPM etc., calibration of WTI, Buchholz relay etc.		
	\$ Rate to be quoted for commissioning only.		
G.1.1	Fabrication and erection of frames and structures	20 MT#	
G.1.2	Filtration of transformer oil	60 kl#	
G.1.3	Aluminium Welding (up to 10mm thick)	50 m#	
G.1.4	Aluminium Welding (11 to 20mm thick)	50 m#	

NOTE TO BOM:

1. The BOM Ref. no given above may be linked with the BOM Ref no in Price bid.
2. The Price bid contains the consolidated list of BOM with brief description of items.
3. Rates are to be filled only in the Price bid.
4. Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOM as well as Scope of Work as specified in relevant Clause of this document.
5. The quantity indicated in the BOM / Price bid is approximate only and is liable for variation. Payment will be as per actual qty erected / commissioned as certified by BHEL Engineer.

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VOLUME-IA PART –I CHAPTER -X GENERAL

The scope of the work will comprise of but not limited to the following:

- 1.10.1 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre-commissioning, commissioning and post-commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.
- 1.10.2 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works. The contractor shall have valid ELECTRICAL CONTRACTOR LICENSE to carry out the scope / job mentioned in the BOM.
- 1.10.3 It is not the intent to specify herein all details of material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.10.4 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.
- 1.10.5 The contractor shall take full responsibility for satisfactory testing, pre-commissioning, commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify the same for proper operation. Testing shall also include any additional tests, which the Engineer feels necessary because of site conditions and also to meet system specification.
- 1.10.6 The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
- 1.10.7 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

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- 1.10.8 Contractor shall erect all items / materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials / work fronts etc will decide the sequence of erection / commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection / commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.
- 1.10.9 During the course of erection, testing and commissioning of electrical work, certain rework / modification / rectification / repairs / fabrication etc. may be necessary on account of feed back from other power stations or units already commissioned and / or units under erection and commissioned and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously and shall be deemed to be part of the scope of work.
- 1.10.10 After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.
- 1.10.11 Contractor shall, transport all materials to site and unload at site / working area, or pre-assembly yard for inspection and checking. All material handling equipment required shall be arranged by the contractor.
- 1.10.12 Contractor shall retain all T&P / Testing instrument / Material handling equipments etc at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge
- 1.10.13 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor.
- 1.10.14 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

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- 1.10.15 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge
- 1.10.16 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However completion time for erection agreed will be subject to the condition that contractor's work is not hampered by the agencies.
- 1.10.17 All the surplus, damaged, unused materials, package materials, containers, special transporting frames, gunny bags etc. shall be returned to the BHEL stores / customer's stores by the contractor.
- 1.10.18 Wherever erection sequences are furnished by BHEL , the contractor shall follow the same sequence.
- 1.10.19 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.
- 1.10.20 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
- 1.10.21 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.
- 1.10.22 The contractor must obtain the signature and permission of the security personnel of the customer for bringing any of their materials inside the sit premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.
- 1.10.23 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
- 1.10.24 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.

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- 1.10.25 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.26 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2000 Standards.
- 1.10.27 For other agencies, such as piping, Boiler, ESP, instrumentation, insulaton etc., to commence their work from / on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the over all project schedule.
- 1.10.28 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
- 1.10.29 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.30 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.
- 1.10.31 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.
- 1.10.32 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.
- 1.10.33 Prior to erection of any components inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.
- 1.10.34 All the equipments /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect..
- 1.10.35 It is the responsibility of the contractor to do the alignment, checking, etc. if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.

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1.10.36 No temporary supports shall be welded on the pressure parts of piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.

1.10.37 SITE INSPECTION

The owner / employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL. Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.10.38 ELECTRICAL INSPECTORATE'S APPROVAL:

1.10.38.1 All electrical installation covered in contractors scope which also includes equipments covered in commissioning assistance are to be inspected / approved by the electrical inspector / statutory authority. For getting electrical inspector approval, contractor shall arrange the following:

- a. Completion certificate for all the equipment covered in the contract
- b. Copy of Test results conducted at site for all the equipment including Electrical Equipment erected by Mechanical Contractor.
- c. All other documents as required by statutory authority.
- d. Contractor shall carry out the modifications / rectifications if any as suggested by the authority at his cost. However, it is not applicable for equipment erected by Mechanical contractor.

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- e. Contractor shall also have valid electrical installation license on his company as well as for individuals acceptable to respective state electrical inspectorate requirement.

1.10.38.2 BHEL shall pay all other fees (FEES FOR VISITS, DRAWING APPROVALS, INSPECTION FEES, REGISTRATION FEES, ETC). However any expenditure related to documentation shall be borne by contractor.

1.10.6 MANPOWER REQUIREMENT

Manpower requirement for Erection and Commissioning shall as follows:

- 1.10.6.1 There shall be a Resident manager as Site In Charge at site, under whom there shall be 3 erection engineers who shall be in charge of TRANSFORMER, BUSDUCT, HT SWITCHGEAR.
 - a. Resident Engineer should have a minimum qualification of Engineering Degree or Diploma in Engineering with 15 years of experience in Thermal Power Station.
 - b. Supervisor should have a minimum qualification of Diploma in Engineering or a graduate with 10 to 15 years of experience in Thermal Power Station.
 - c. Lab Technicians should have experience in Thermal Power Stations.
- 1.10.6.2 Each area engineer shall be provided with minimum four supervisors and adequate number of Technicians / electricians and other erection staff and T&P etc. The testing Engineers / supervisors / electricians shall be identified separately for each package and the minimum requirement shall be as indicated in previous Clause. Besides, there shall be separate engineers for Planning, Safety and Quality.
- 1.10.6.3 The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.
- 1.10.6.4 All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name his authorized representative prior to or immediately on commencement of operations at site
- 1.10.6.5 The Site In charge shall be present at site during all normal working hours and his contact address after normal working hours shall be made available to BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.

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- 1.10.6.6 The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed suffering delay on this account.
- 1.10.6.7 The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of his duties the contractor shall remove them from site as directed by Site Engineer.
- 1.10.6.8 The contractor shall ensure that all his supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.
- 1.10.6.9 The contractor shall ensure that replacement for such persons removed from site is provided immediately and the work is not allowed to suffer delay on that account.
- 1.10.6.10 Contractor should have one Store Keeper and one Transport Supervisor for the safe transportation of materials.

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VOLUME-IA PART –I CHAPTER -XI FOUNDATIONS AND GROUTING

The scope of the work will comprise of but not limited to the following:

- 1.11.1 Foundation for the equipments (Transformers etc) to be erected shall be provided by BHEL / clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments plants shall be carried out by the contractor.
- 1.11.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.
- 1.11.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates/shims, and may be required for the erection of the equipment/plants will have to be carried out by the contractor without extra cost.
- 1.11.4 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipments
- 1.11.5 Foundation pockets are to be cleaned thoroughly before placing the columns/equipments. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.
- 1.11.6 The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment. Packer plates should not only be blue matched with foundation but also inter-packer contact surfaces between the packers and foundation frame etc., shall also be blue matched by Prussian Blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineers instructions.
- 1.11.7 The certificates of the grout is to be submitted BHEL. If necessary test cubes are to be made and tested at site to ensure the quality of the grout as per

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relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc to be arranged by the contractor including the fine aggregates.

- 1.11.8 All the materials required for grouting including special cements like Conbextra GPI,GP2, ACC- Shrinkkomb-N20, Sika Anckor, NSG/ NSG -1, CICO Excem GP, or its equivalent as approved by BHEL and other materials like Portland cement, sand etc., are to be arranged by the contractor at his cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.
- 1.11.9 Certain packer plates and shims over and above the quantity received as part of supplies from manufacturing units of BHEL will have to be cut out from steel plates / sheets at site by the contractor to meet site requirement. However machining of the packers, wherever necessary, will be arranged by BHEL at free of cost.
- 1.11.10 Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.
- 1.11.11 **PROCEDURE FOR GROUTING :**
Contractor has to carryout the grouting as per the work instructions for grouting available at site.

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VOLUME-IA PART –I CHAPTER -XII MATERIAL HANDLING AND SITE STORAGE

The scope of the work will comprise of but not limited to the following:

- 1.12.1 The equipment should be preferably in its original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.
- 1.12.2 The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damp, sinking into ground and to circulate air under the stored equipment. This will also help in lifting the packing with fork-lift truck.
- 1.12.3 Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolorisation takes place or regenerated.
- 1.12.4 Due care should be taken to ensure that the equipment is not exposed to fumes gases etc. which can affect electrical contacts of relays and terminal boards.
- 1.12.5 The storage room and the equipment should be checked at regular interval of 3 months to ensure protection from termites, mould growth, condensation of water etc. which can damage the equipment.
- 1.12.6 All the equipment, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to site.
- 1.12.7 Packing material shall be retained if the cubicle to be repacked after inspection.
- 1.12.8 Sub-Assemblies
 - a) All sub-assemblies should be kept in a separate place where it is easily accessible.
 - b) Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it.
 - c) Sub-assemblies should not be stacked one above the other.
- 1.12.9 Loose items (wherever applicable)

The loose items supplied for the main equipment falling into various categories like tools, cables, recorders and display units, cable glands, frames etc. are to be categorised and stored separately.
- 1.12.10 Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

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- 1.12.11 Sometimes it may become necessary for the contractor to handle certain unrequired components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.
- 1.12.12 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.
- 1.12.13 Contractor has to arrange required fire resistant tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.
- 1.12.14 The contractor shall take delivery of item, materials, from the storage yard / stores / sheds of BHEL / customer which is within a radius of 5 kms. He shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to him till they are fully erected, tested and commissioned. The contractor shall note that items/materials shall be transported to erection site / assembly yard etc. by the prescribed route without disturbing and causing damage to other works in the most professional manner. Items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.
- 1.12.15 The contractor shall take delivery of items / materials, and consumables from the stores / storage area / sheds of BHEL / customer after getting approval of engineer / customer in the prescribed indent forms of BHEL / customer.
- 1.12.16 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipments from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.
- 1.12.17 The equipments / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

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VOLUME-IA PART –I CHAPTER -XIII SCOPE OF WORKS-DETAILED

1.13.1 TRANSFORMERS

SCOPE OF SUPPLY AND SPECIFICATION OF TRANSFORMERS

Different types of transformers like oil immersed or dry type shall be supplied as indicated below. Generator Transformer, Unit Transformer, Standby Transformer and Unit Auxiliary Transformer will be located adjacent to the powerhouse building in the transformer yard. Oil filled station service transformer & VFD transformers will be located adjacent to the respective Service building. The dry type service transformer shall be installed inside MCC room.

1.13.1.1 DETAILED SPECIFICATION OF TRANSFORMERS (Weight and dimensions are approximate)

1.13.1.1.1 GENERATOR TRANSFORMER- QUANTITY- 7 sets

240 MVA, $(420/\sqrt{3})/21$ kV, 3 x 1 phase, OFAF, YNd11 Generator Transformer with OFTC $\pm 10\%$ in steps of 1.25%.

i) Approximate Dimensions

- a. Overall dimensions (Unit) : (l x b x h) (mm) 13600 x 6200 x 11000
- b. Shipping dimensions : (l x b x h) (mm) 7250 x 3880 x 4800
- c. Height for unloading : (mm) 12000

ii) Weight of Transformer Components

- a. Core and Winding Assembly (Kg) 165000
- b. Tank and Fittings (Kg) 35500
- c. Oil weight (Kg) 47500
- d. Total weight (Kg) 248000
- e. Shipping weight (Kg) 182000
- f. Total Oil quantity (Ltrs) 54500

iii) Accessories

- a) 6 X 20% Coolers of size: 1700 x 1200 x 3500 (mm) and weight 1500 kg each
- b) Bushings
 - i) 1 No. HV Bushing of size 720(dia) x 720(dia) x 6250(h) mm; weight: 1500 kg each
 - ii) 2 Nos. LV Bushings of size 500(dia) x 500(dia) x 1300(h) mm; weight: 550 kg each
 - iii) 1 No. Neutral Bushings of size 250(dia) x 250(dia) x 1400(h) mm; weight: 50 kg each

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- c) Turrets
 - i) 1 No. HV Turret of size 1150(dia) x 1150(dia) x 1500(h) mm; weight: 500 kg each
 - ii) 1 Nos. LV Turret of size 3050(dia) x 1150(dia) x 750(h) mm; weight: 950 kg each
 - iii) 1 No. Neutral of size 500(dia) x 550(dia) x 400(h) mm; weight: 60 kg each
- d) 1 No. Conservator of size 1300(dia) x 1300(dia) x 3700 (h) mm; weight: 1100 kg and pipe works of weight 700 kg
- e) Cooler Control Cabinet of size 350(b) x 1780(l) 1930(h) mm; weight 450 kg each
- f) Common Kiosk of size 605(b) x 1525(l) x 1610(h) mm; weight 600 kg each
- g) PRV with oil collector & drain pipe-02 nos., MOLG, Thermometer on cooler pipe-02 nos., Buchholz relay & Gas collecting device with 6mm dia copper pipe, Breathers, Sudden pressure relay, Oil flow indicator-06 nos., Flexible metal hose-12 nos., Neutral grounding copper conductor (100x25mm) with post insulators, Off circuit tap changer driving unit-01 no., Bevel Gear unit – 01 no., Oil pump and motor – 06 nos., Cooler fan-06 nos., Inlet valves -02 nos., Outlet valve-01 no.
- h) Pipe support material – 04 Nos.
- i) Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel.
- j) 01 No. Electronic Enclosure with dissolved gas monitoring system and mounting bracket.
- iv) All internal cabling along with cable tray.
- v) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.2 UNIT TRANSFORMER- QUANTITY- 4 sets

50/40 MVA, 21/11.5 KV, 3 phase, ONAN/ONAF, Dyn1 Unit Transformer with On Load Tap Changer +7.5 % to -12.5 % in steps of 1.25% on HV side.

i) Approximate Dimensions

- a. Overall dimensions (mm) 10000 x 6000 x 7000 (l x b x h)
- b. Shipping dimensions (mm) 5200 x 3600 x 4000 (l x b x h)
- c. Height for untanking (mm) 9000

ii) Weight of Transformer

- a. Core and Winding (Kg) 35000
- b. Tank and Fittings (Kg) 27000

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- c. Oil weight (Kg) 26000
- d. Untanking weight (Kg) 35000
- e. Shipping weight (Kg) 48000
- f. Total weight (Kg) 88000
- g. Total Oil quantity (Ltrs) 34000

iii) Transformer Accessories

- a. 12 Nos. Radiators of size 1450 x 520 x 3000 (mm) and weight 300 kg each.
 - b. 1 No. Main Conservator of size 1100(dia)x3500 (l)mm and wt. 1100 kg
 - c. 1 No. Aux. Conservator of size of 300 (dia) x 820(l)mm.
 - d. 4 Nos. Header; Wt. 375 Kg each.
 - e. Pipe work of weight 750 kg
 - f. Cooling Fans: 10 Nos. Size: 24" ; weight-20 kg
 - g. HV Bushings: 3 Nos. of weight 100 kg each
 - h. LV Bushings: 3 Nos. of weight 50 kg each
 - i. Neutral Bushing: 1 No. of weight 50 kg
 - j. Cooler Control Cabinet: 1 No. 600 kg
 - k. Motor Drive Unit : 1 No. 100 kg
 - l. Bevel Gear unit – 01 No.
 - m. PRV , RTD, Buchholz relay, Breather, Oil surge relay for OLTC, Thermometer, Pressure gauge, Loose Valves (25/50/100 NB-14 nos.) Hard copper strip along with post insulator for Neutral earthing.
 - n. 'A' frame assembly 02 nos. for radiator.
 - o. Fan support assembly 10 nos.
 - p. Loose items like raise / lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel.
- iv) All internal cabling along with cable tray.
- v) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.3 STAND BY TRANSFORMER - QUANTITY-1 set.

50 MVA 230KV/11.5 KV, 3 Phase ONAN/ONAF, YNyn0

Standby Transformer with OLTC + 7.5% to -12.5% in steps of 1.25% on HV Side.

i) Approximate Dimensions

- a. Over all Dimensions (mm) 12600x6700x7740 (l x b x h)
- b. Shipping Dimensions (mm) 6200x3100x4000 (l x b x h)
- c. Height for untanking (mm) 10000

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ii) Weight of Transformer Components:

- | | | | |
|----|--------------------|--------|--------|
| a. | Core & Winding | (Kg) | 43000 |
| b. | Tank and Fittings | (Kg) | 38000 |
| c. | Oil | (Kg) | 34000 |
| d. | Untanking weight | (Kg) | 43000 |
| e. | Total weight | (Kg) | 115000 |
| f. | Shipping weight | (Kg) | 60000 |
| g. | Total Oil Quantity | (Ltrs) | 38000 |

iii) Transformer Accessories:

- a. 12 Nos. Radiators each of size (lxbxw) 1500x550x3000mm and weight 400kg each.
 - b. Bushings
 - i) 3 Nos. HV Bushings; Weight: 400 Kg each.
 - ii) 3 Nos. LV Bushings; Weight : 40 Kg each.
 - iii) 1 No. LV Neutral Bushing; Weight : 40 Kg.
 - iii) 1 No. HV Neutral Bushing; Weight : 40 Kg.
 - c. Marshalling Box – 1 No; Wt: 600 Kg.
 - d. 01 No. Main Conservator of size 1300 Dia x 3500(l) mm; Wt.1200Kg.
 - e. 01 No. Aux. Conservator of size 400 Dia x 820(l).
 - f. Turrets
 - 1 No. LV Turret: 1500(l) x 500(W); Wt. 650 Kg.
 - 1 No. LV Neutral Turret.
 - 3 Nos. HV Turret : 400(dia) x 300(l); Wt. 250 Kg.
 - 1 No. HV neutral Turret.
 - g. Cooling Fans: 8 Nos. Size: 24” ; weight-20 kg
 - h. Pipe work of weight 750 Kg.
 - i. 4 Nos. Header; Wt. 375 Kg each.
 - j. 1 No. Motor Drive Unit 600x350x1100; Wt. 100 Kg.
 - k. Bevel Gear Unit-01 No.
 - l. PRV , RTD, Buchholz relay, Breather, MOLG, Oil surge relay for OLTC, Thermometer, Pressure gauge, Loose valves (25/50/80/150 – 12 Nos.), Hard copper strip along with post insulator for Neutral earthing, etc
 - m. ‘A’ frame assembly 02 nos. for radiator.
 - n. Fan support assembly 8 nos.
 - o. Loose items like raise/lower P.Bs, tap changer indicators, facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel.
- iv) All internal cabling along with cable tray.
- v) Final painting shall be done as per spec and approval of BHEL

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1.13.1.1.4 UNIT AUX. TRANSFORMER- QUANTITY- 4 sets.

16 MVA, 11/3.5 kV, 3 phase, ONAN, Dyn1 Unit Aux. Transformer with Off Load Tap Changer 5 % to -5 % in steps of 2.5% on HV side.

i) Approximate Dimensions

- | | | | |
|-------------------------|------|--------------------|-------------|
| a. Overall dimensions | (mm) | 7200 x 5500 x 5600 | (l x b x h) |
| b. Shipping dimensions | (mm) | 4600 x 2500 x 2900 | (l x b x h) |
| c. Height for untanking | (mm) | 8000 | |

ii) Weight of Transformer

- | | | |
|-----------------------|----------|-------|
| a. Core & Winding | (Kg) | 16700 |
| b. Tank and Fittings | (Kg) | 13330 |
| c. Oil | (Kg) | 9750 |
| d. Untanking weight | (Kg) | 16700 |
| e. Total weight | (Kg) | 39780 |
| f. Shipping weight | (Kg) | 32000 |
| g. Total Oil Quantity | (Ltrs) | 10950 |

iii) Transformer Accessories

- a. 9 Nos. Radiators of size 1700 x 360 x 2200(mm); Weight 500 kg.
- b. 1 No. Conservator of size 1050(dia) x 1850 (l); Weight 950 kg.
- c. Pipe work of weight 750 kg.
- d. HV Bushings :3 Nos; Weight 20 kg each.
- e. LV Bushings : 3 Nos; Weight 40 kg each
- f. Neutral Bushing : 1 No; weight 40 kg.
- g. 01 No. LV Frame Turret size of 1310(l)x520(b)x500(h)
- h. 01 LV Neutral Frame Turret size of 510(l)x510(b)x510(h)
- i. 01 No. HV Bushing disconnecting chamber along with HV cable box
- j. Cable box supports.
- k. Marshalling Box: 1 No; Wt: 450 Kg.
- l. PRV, RTD, Buchholz relay, Breather, Thermometer, Pressure gauge, loose Valves (80 NB-02 nos.), Hard copper strip & flexible jumper along with post insulator for HV Neutral earthing.
- m. Loose items like facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. will be supplied loose, to be mounted and wired in control panel.

iv) All internal cabling along with cable tray.

v) Final painting shall be done as per spec and approval of BHEL.

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1.13.1.1.5 STATION SERVICE TRANSFORMERS(Dry type) - QUANTITY-4 sets

i) Specification

2500 KVA, 11KV/433 V, 3 phase, AN, 50 Hz, Dyn11, indoor, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box, LV Non Segregated Phase Bus duct connections, other accessories etc.

ii) Overall dimensions: 2800 x 2165 x 2750 mm (Approx)

iii) Weight of Transformer Components

Core Coil Assembly	7000 Kg
Enclosure	1000 Kg
Total Shipping weight	8000 Kg

iv) All internal cabling along with cable tray to be done.

v) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.6 UNIT SERVICE TRANSFORMERS (Dry type) - QUANTITY-4 sets.

2500 KVA, 11KV/433 V, 3 phase, AN, 50 Hz, Dyn11, indoor, dry type cast resin Transformer, HV bushings rated for 12 kV, Marshalling Box, HV Cable box, LV Non Segregated Phase Bus duct connections, other accessories etc.

i) Approximate dimensions

Overall dimensions: 2800 x 2165 x 2750 mm (Approx)

ii) Weight of Transformer Components

Core Coil Assembly	7000 Kg
Enclosure	1000 Kg
Total Shipping weight	8000 Kg

iii) All internal cabling along with cable tray to be done.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.7 SERVICE TRANSFORMER – 1600 KVA - QUANTITY- 22 sets.

1600 KVA, 11KV/433 V, 3 phase, 50 Hz, Dyn11, ONAN, OFF Circuit taps $\pm 5\%$ in steps of 2.5% with HV Cable box, LV Bus duct Term. Connection, Conservator, Silica gel, breather with oil seal, rollers, cooling radiators, Shut off valve between Buchholz relay and conservator, HV disconnecting chamber, etc.

i) Approximate dimensions

a. Overall dimensions	(mm)	3210 x 2100 x 2520	(l x b x h)
b. Shipping dimensions	(mm)	3040 x 1880 x 2390	(l x b x h)
c. Height for untanking	(mm)	3600	

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ii) Weight of Transformer Components

Core and Winding	- 2180 Kg
Tank & Fittings	- 1880 Kg
Oil	- 830 Kg
Total weight	- 4890 kg
Weight of heaviest package	- 3930 kg
Total Oil Quantity	- 1050 Ltrs.

iii) All internal cabling along with cable tray to be done.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.8 SERVICE TRANSFORMER – 2000 KVA - QUANTITY- 5 Sets

2000 KVA, 11KV/433 V, 3 phase, 50 Hz, Dyn11, ONAN, OFF Circuit taps $\pm 5\%$ in steps of 2.5% with HV Cable box, LV Bus duct Term. Connection, Conservator, Silica gel, breather with oil seal, rollers, cooling radiators, Shut off valve between Buchholz relay and conservator, HV disconnecting chamber, etc.

i) Approximate dimensions

a.	Overall dimensions	(mm)	3350 x 2530 x 2540	(l x b x h)
b.	Shipping dimensions	(mm)	3180 x 1950 x 2410	(l x b x h)
c.	Height for untanking	(mm)	3600	

ii) Weight of Transformer Components

Core and Winding	- 2180 Kg
Tank & Fittings	- 2170 Kg
Oil	- 1070 Kg
Total weight	- 5420 kg
Weight of heaviest package	- 4090 kg
Total Oil Quantity	- 1300 Ltrs.

iii) All internal cabling along with cable tray to be done.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.9 SERVICE TRANSFORMER – 2500 KVA - QUANTITY- 2 Sets

2500 KVA, 11KV/433 V, 3 phase, 50 Hz, Dyn11, ONAN, OFF Circuit taps $\pm 5\%$ in steps of 2.5% with HV Cable box, LV Bus duct Term. Connection, Conservator, Silica gel, breather with oil seal, rollers, cooling radiators, Shut off valve between Buchholz relay and conservator, HV disconnecting chamber, etc.

i) Approximate dimensions

a.	Overall dimensions	(mm)	3470 x 2870 x 2760	(l x b x h)
b.	Shipping dimensions	(mm)	3300 x 1980 x 2530	(l x b x h)
c.	Height for untanking	(mm)	3900	

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ii) Weight of Transformer Components

Core and Winding	- 2950 Kg
Tank & Fittings	- 2790 Kg
Oil	- 1260 Kg
Total weight	- 7000 Kg
Weight of heaviest package	- 5130 Kg
Total Oil Quantity	- 1600 Ltrs.

iii) All internal cabling along with cable tray to be done.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.10 SERVICE TRANSFORMER– 3500 KVA - QUANTITY- 04 Sets

3500 KVA, 11KV/3.5 KV, 3 phase, 50 Hz, Dyn1, ONAN, OFF Circuit taps $\pm 5\%$ in steps of 2.5% with HV Cable box, LV Bus duct Term. Connection, Conservator, Silica gel, breather with oil seal, rollers, cooling radiators, Shut off valve between Buchholz relay and conservator, HV disconnecting chamber, etc.

i) Approximate dimensions

a. Overall dimensions	(mm)	3560 x 2660 x 3050	(l x b x h)
b. Shipping dimensions	(mm)	3250 x 2150 x 2380	(l x b x h)
c. Height for untanking	(mm)	4500	

ii) Weight of Transformer Components

Core and Winding	- 3840 Kg
Tank & Fittings	- 3060 Kg
Oil	- 1400 Kg
Total weight	- 8300 kg
Weight of heaviest package	- 6200 kg
Total Oil Quantity	- 1800 Ltrs.

iii) All internal cabling along with cable tray.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.11 VFD TRANSFORMERS– 8 Sets

5000 KVA, 11/4.1KV, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with conservator tank with MOLG, Double float Buchholz relay with 02 nos. valves, Silica gel breather with pipe, P.S. Radiator-08 nos., HV/LV/LVN cable box with disconnecting chamber, Marshalling box, PRV, Remote winding temperature indicator, etc.

i) Approximate dimensions

a. Overall dimensions	(mm)	4025 x 3400 x 3250	(l x b x h)
b. Shipping dimensions	(mm)	3800 x 2100 x 2200	(l x b x h)

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ii) Weight of Transformer Components

Core and Winding	- 5600 Kg
Tank & Fittings	- 4100 Kg
Oil	- 2400 Kg
Total weight	- 12100 kg
Weight of heaviest package	- 10285 kg
Total Oil Quantity	- 2695 Ltrs.

iii) All internal cabling along with cable tray.

iv) Final painting shall be done as per spec and approval of BHEL

1.13.1.1.12 N.G.R (11KV) QUANTITY – 05 Nos.

11 KV, 300A, 22.13 Ohms, outdoor type NGR with support structure, Copper strip, HT porcelain support insulator, Foundation bolts, etc.

The scope of erection work includes final painting, minor civil work such as chipping and grouting of the support structure

1.13.1.1.13 N.G.R (3.3KV) QUANTITY – 08 Nos.

3.3 KV, 300A, 6.74 Ohms, outdoor type NGR with supporting structure, Copper strip, HT porcelain support insulator, Foundation bolts, etc.

The scope of erection work includes final painting, minor civil work such as chipping and grouting of the support structure

1.13.1.2 SCOPE OF WORK OF TRANSFORMER

1.13.1.2.1 Receipt of all accessories & Spares including oil in drums from site store/yard, inspection, handling of accessories between stores & transformer yard / location upto respective plinth, storage, maintenance of N2 gas pressure in transformer tank, erection of all the accessories, cabling from transformer accessories, to marshalling KIOSK & OLTC panel, oil filling, GT Neutral formation, oil pressure testing dry out, pre-commissioning test, commissioning of equipment and final painting and handing over.

Note: Refer VOLUME-IA PART- II CHAPTER -2 of this tender spec for general technical requirements for erection, testing and commissioning

1.13.1.2.2 Transformers that are to be mounted adjacent to PH building shall be transported and placed in the unloading bay of the power house in suitable wagon/trailer. The contractor will unload the transformers on rails, turn the wheels/rollers if necessary for changing over at right angles on rails, roll the transformers to their respective locations and put them on the foundation. The necessary sleepers, winches, jacks etc. required for this operation will be arranged by the contractor at his cost. The other transformers will be shifted with suitable material handling equipment to the respective location.

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- 1.13.1.2.3 Generator, Standby, UT and UAT and other transformers will be sent to site in several packages which will have to be erected / assembled at site. Contractor shall arrange to assemble at site and carry out testing as mentioned above
- 1.13.1.2.4 Samples of each and every drum of Transformer oil have to be tested and pre-treated to achieve the desired value before filling in to the transformer tank. The entire arrangement for testing the oil sample, filtering whenever required to achieve the desired PPM, BDV within the shortest time shall be made by the contractor. Oil tests as per IS 335 including dissolved gases analysis has to be conducted by contractor for transformers of rating above 200 KV. The job has to be taken up in consultation with BHEL Engineers at site at the cost of the contractor. All the test equipment for testing PPM, BDV of the oil including testing equipment required for the Tan-Delta Test of the transformer winding and HV Bushing shall be arranged by the contractor. Condenser bushings shall be tested for capacitance and tan delta test before erection also. Testing instruments required for DEW measurement of N2 gas shall also be arranged by the contractor
- 1.13.1.2.5 All the T&P, material handling equipment like cranes, Trailer, 2 (two) number of High Vacuum filter machines with adequate capacity (5 to 6 KL/hr), vacuum pumps and 5 kV motorized megger and oil tank of suitable capacity shall be arranged by the contractor at his cost. Contractor shall arrange one no 1 to 1.5 kl/hr filtration machine for filtration of smaller transformers. BHEL will give one no 5 to 6kl/hr filtration machine, free of hire charges. Filtration machine issued from BHEL shall be returned in good working condition. The transformers may have to be suitably lagged / covered during the drying out operation by the contractor at no extra cost.
- 1.13.1.2.6 The contractor will engage his men on three-shift operation during drying out the transformers.
- 1.13.1.2.7 Auxiliary / Service transformers will be bolted to the adopter panel / bus duct on both the sides and the busbars will be connected together. The contractor at no extra cost shall carry out any modification required in the bus connectors for matching the PCC Bus bar with the transformers LT side.
- 1.13.1.2.8 The auxiliaries components of the above transformers are to be cleaned and checked before the assembly as instructed by BHEL Engineer.
- 1.13.1.2.9 The contractor shall carry out testing and commissioning works by their own testing equipments and Testing Engineers under the supervision of BHEL Engineer.
- 1.13.1.2.10 Filtration and dry out shall be carried out to obtain value of dielectric strength / PPM, resistivity, specific gravity, dissolved gas analysis, and Tan-Delta test shall be as per recommended value of BHEL. The final tests have to be carried out at approved laboratories like TNEB / CPRI etc. and test certificates are to be submitted to BHEL. If the test results are not satisfactory

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and if the customer desires to carry out the tests through some other agency, the same shall be carried out at contractor's cost.

- 1.13.1.2.11 All the transformers protective system such as Buchholz relay explosion vent, oil and winding temperature detectors etc., healthiness are to be checked under the guidance of BHEL Engineer. All condenser bushings will have to be tested for capacitance and tan delta value. All transformers of 220 KV and above shall be tested for capacitance and tan delta value after commissioning.
- 1.13.1.2.12 Transformer protective relays are to be checked prior to the commissioning of the transformer.
- 1.13.1.2.13 The scope of erection work includes final painting, minor civil work such as chipping and grouting of the support structure as well as for the support of the transformer. Final painting shall be carried out for all the Transformers excepting 8 Nos. Dry type Indoor Transformers. The scope of final painting involves supply of paints, thinner and other consumables at the cost of the contractor as detailed in VOLUME-IA PART- I CHAPTER-XVI (Painting). No separate rate shall be paid for painting.
- 1.13.1.2.14 During the oil circulation of the transformer, the contractor has to employ sufficient number of personnel who will take care of the operation of the filter machine as well as safety of the transformer.
- 1.13.1.2.15 The contractor shall prepare all log sheets, test certificates, protocols etc. as per field quality plan, get it signed by concerned BHEL / TNEB Engineer and submit to the concerned BHEL Engineer
- 1.13.1.2.16 Preservative gas like N₂ shall be supplied by BHEL free of cost to maintain the N₂ pressure during preservation
- 1.13.1.2.17 The contractor shall maintain the equipment erected and commissioned by him until taken over by TNEB.
- 1.13.1.2.18 BHEL will provide 75 / 18 Ton capacity cranes for the purpose of erection of transformer assembly on sharing basis at free of hire charges. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.
- 1.13.1.2.19 BHEL will provide one 5 to 6 kl/hr filtering machine and tank at free of hire charges. However, the contractor shall arrange transportation from BHEL store, operator and other consumables. The contractor shall arrange one 5 to 6 kl/hr, and one 1 to 1.5kl/hr filtering machine additionally to the meet erection / commissioning schedule. All the free issue equipments shall be returned to BHEL in good condition and any defects noticed at the time of handing over shall be rectified by the contractor.
- 1.13.1.2.20 Contractor shall arrange to paint / stick good quality danger boards where ever required. Required boards shall be arranged by contractor. Name of the

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equipment erected by the contractor shall be painted boldly as per the agreed colour scheme on the equipment.

1.13.2 HT SWITCHGEARS - 11 / 3.3 KV & GENERATOR / TRANSFORMER CONTROL / RELAY PANELS AND OTHER CONTROL PANELS INCLUDING VFD PANELS, AVR etc

1.13.2.1 GENERAL CONSTRUCTION AND OPERATION OF HT SWITCHGEAR:

Different type of HT switchgears shall be supplied. 11/3.3 KV HT Switchgear shall be installed at 3.5m level in PH building.

HT switchgears are of Type VM12 metal clad switchgear is of horizontal drawout pattern, suitable for easy extension of switchboard on both directions for systems upto 12 KV. The design incorporates single busbar system and a set of interlocks for safety of operations and is fully compartmentalized. A panel consists of a fixed portion (and a moving portion) of modular construction having three high voltage chambers namely breaker chamber, busbar chamber and CT chamber. Instrument panel is a separate low voltage chamber. Moving portion comprises of wheel mounted truck fitted with an operating mechanism, vacuum interrupters & isolating contacts.

Motor operated spring closing mechanism keeps the springs charged after every closing operation making it ready for next reclosure. Springs can also be charged manually in case of failure of auxiliary power to the spring charging motor. The tentative details are as under.

1.13.2.2 DETAILED SPECIFICATION OF SWITCHGEAR

11KV SWITCHGEAR

Details of equipment:

System Nominal	: 11 KV, 3 PHASE, 50 Hz
System Voltage Highest	: 12 KV
Neutral	: Resistance Earthed
Insulation level	: 12 KV / 28 KV / 75 KVP
Breaking Capacity	: 40 KA AT 12 KV
Making Capacity	: 100 KAp
STC	: 40 KA, FOR 3 seconds
Top Busbar	: 3150 A

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3.3 KV SWITCHGEAR

Details of equipment:

System Nominal	: 3.3 KV, 3 PHASE, 50 Hz
System Voltage Highest	: 3.6 KV
Neutral	: Resistance Earthed
Insulation level	: 3.6 KV / 10 KV / 40 KVP
Breaking Capacity	: 40 KA AT 3.3 KV
Making Capacity	: 100 KAp
STC	: 40 KA, FOR 3 seconds
Top Busbar	: 3150 A (1CA & 2CA Panels) 630 A (OCA & OCB Panels)

The switchboards are divided into various sections and the details are as given below.

SI. No	HT	DES	QUANTITY	DIMENSION OF EACH PACKAGE IN MM	WEIGHT OF EACH PACKAGE
1	11 KV	1BA	30 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
2	11 KV	1BB	21 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
3	11 KV	OBA	09 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
4	11 KV	2BA	30 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
5	11 KV	2BB	21 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
6	3.3 KV	1CA	36 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
7	3.3 KV	2CA	36 PANELS	820(W)X2651(D)X2692(H) MAX	1500 KG/PANEL
8	3.3 KV	OCA	24 PANELS	820(W)X2355(D)X2692(H) MAX	1500 KG/PANEL
9	3.3 KV	OCB	15 PANELS	820(W)X2355(D)X2692(H) MAX	1500 KG/PANEL

1.13.2.3 SCOPE OF WORK FOR HT SWITCH BOARD & GENERATOR / TRANSFORMER CONTROL / RELAY PANELS AND OTHER CONTROL PANELS LIKE VFD, AVR etc:

- The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.
- The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. All minor concrete chipping and finishing works

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are deemed to be included in the scope of the job. If base frame is to be fabricated / erected, separate rate shall be paid for the executed tonnage as per the rate for fabrication and erection of frames and structures (Refer BOM ref no G.1.1 of price bid). Contractor to arrange anchor bolts required if any.

- iii. For the panels to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted.
- iv. The contractor shall carry out fabrication and erection of these support structures and separate rate shall be paid on Tonnage basis.
- v. The contractor shall set each section of equipment on its foundation or supporting structures. The contractor shall assemble equipment as required. Skilled craftsmen arranged by the contractor shall install all equipment with parallel, horizontal and vertical alignment.
- vi. Panels will be delivered in different shipping sections. Necessary interconnection of busbar, inter panel wiring, etc. shall be carried out as part of panel erection.
- vii. Normally the panels shall be supplied with complete Relays / Instruments and other Components mounted and wired. However, any minor modifications like dismantling of the existing Relays / Instruments / Components and mounting of new Relays / instruments / components and rewiring to suit operating conditions, will be carried out without any extra cost. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra works basis. Similarly if any Relays/ Instruments /component supplied as loose for safety transit, same shall be mounted and wired as per site requirement at free of cost as part of scope of the job. However, if the loose supplied Relays / Instruments / Components are more than 10% of the total quantity, the same shall be carried out at extra works basis. Decision of site engineer shall be final regarding such extra works.
- viii. The commissioning of HT Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and Service Transformer. The contractor will have to keep his people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc. required in the equipment erected by him. (Separate rate shall be paid for commissioning of associated electrical drives as per BOM). Contractor has to co-ordinate with LT and C&I contractors to make the interconnecting cables through.
- ix. The contractor has to do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.
- x. All T&P, Material handling equipment including cranes and Relay Testing / HV Testing / Calibration equipment / Instruments shall be arranged by contractor. Three phase current injection kit required for calibration of relays shall be arranged by the contractor. The contractor shall carry out testing and commissioning works using

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their own testing equipments and Testing Engineers under the supervision of BHEL Engineer. EOT crane shall be given free of cost for shifting the panels from and to electrical room. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.

- xi. Switch boards incomer bus shall be connected to SP bus ducts, through adapter box. The contractor shall co-ordinate for proper bus bar connection. Any modification required in the bus conductor for matching SP bus duct and bus bar, the same shall be carried out without extra cost.
- xii. Contractor shall co-ordinate with cable jointer and other LT cable laying agency for proper cable termination and also during HP testing of cable.
- xiii. The contractor shall prepare all erection/ commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL / TNEB Engineer and submit the same to BHEL Engineer as per his instruction.
- xiv. The charged and commissioned equipment shall be maintained by the contractor till the same is taken over by M/s TNEB
- xv. Any items like lamps, lens, fuse / relays / instruments missed from the custody if the contractor shall be replaced by the contractor at free of cost.
- xvi. Rubber mats for HT switchgear shall be supplied by BHEL, and these shall be laid, wherever required, by the contractor at free of cost.
- xvii. The contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer at free of cost.
- xviii. If any removal / Re-fixing of contactors / relays becomes necessary for the completion of the system, the same shall be done by the contractor at free of cost.
- xix. Scope of work shall also cover drilling of bottom gland plates for cable entry as required.
- xx. The contractor shall calibrate and commission all switchgear / panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc.
- xxi. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments, transducers mounted on the panels.
- xxii. If panels are supplied with monitor, printers, furniture, controller etc. or any loose items or equipments, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items unless specifically given in the BOM.
- xxiii. Contractor shall arrange to paint / stick good quality danger boards where ever required. Required boards shall be arranged by contractor.

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Note:-

1. Dimensions & weights indicated in the BOM against various panels are approximate only. There may be variations in the weight and dimensions. Variations in depth, height or weight of the panel shall not be considered for payment. Any variation upto +20% as compared to actual length indicated in the BOM shall not be considered for payment. However, for variations beyond +20%, payment shall be considered proportional to the length of the panel.
2. BHEL will provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V

1.13.3 BUSDUCTS

1.13.3.1 SCOPE OF SUPPLY

Two types of bus ducts shall be supplied for this project as detailed below.

- a) HT Isolated Phase Busducts from Generator to Generator Transformer
- b) HT Segregated Phase Busduct between Unit Transformers / Standby Transformers / Unit Aux Transformers and 11 kV Switchboards and 3.3 kV Switchboards and associated interconnection / Tie Bus ducts.

1.13.3.2 ISOLATED PHASE BUSDUCTS

The isolated phase bus ducts is connected to the low voltage side of the generator transformer and generator. The bus consists of cylindrical conductor made of Aluminium alloy supported on post insulators. Flexible connections and expansions joints are provided at terminal and intermediate points to alleviate stresses due to expansion and to arrest vibration. All the CTs will be mounted inside the bus ducts.

Isolated phase taps connect the potential transformer, surge protection equipment and unit transformer to the main bus. Each phase of protection equipment and potential transformers shall be housed in metal clad cubicles. Delta formation is carried out externally through Delta busduct.

A totally enclosed neutral grounding cubicle is provided to connect the Generator neutral point. The neutral grounding cubicle houses neutral grounding transformer & resistors. All the generator-isolated bus ducts are supplied with one set of Air pressurization equipment unit.

The tentative details are as under.

1. Rated Voltage : 21 kV
2. Phase : 3 Nos.

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3. Insulation Level

- a) 1 min. Hipot : 55 KV rms
- b) Basic Impulse : 125 KV peak

4. Shipping Data:

Weight of the heaviest package : 4000 kg (Approx.)

Dimensions of largest package (lxbxh) : 3000 x 2500 x 3500 mm(Approx.)

5. Other details of IP Busduct :

		<i>Main Run</i>	<i>Delta Run</i>	<i>Tap-off Run</i>
a	Weight per metre run of IP busduct (3-Phase)	900 kg	500 kg	300 kg
b	Conductor Material	AL. Alloy Gr. 19501	AL. Alloy Gr. 19501	AL. Alloy Gr.63401
c	Enclosure Material	AL. Alloy Gr. 19501	AL. Alloy Gr. 19501	AL. Alloy Gr.31000
d	Conductor Shape	Cylindrical	Cylindrical	(2channels) Box Formation
e	Conductor Cross Section	37800 mm ²	19000 mm ²	7456 mm ²
f	Enclosure Phase Spacing	1750mm	1250mm	1000mm
g	Enclosure outside DIA	1600 mm	1070 mm	876 mm
h	Enclosure thickness	8 mm	6.35 mm	4.78 mm
i	Phase to Earth Clearance	220 mm	220 mm	220 mm
j	Rated continuous current	21000 AMPS	12500 AMPS	3000 AMPS
k	Bus insulator per support	3 Nos.	3 Nos.	3 Nos.

6. Grounding

- a) Material and size of ground bus if provided separately: 50 x 6 GS Flat
- b) Number of ground pads provided for 50 x 6 galvanised steel flat: As per Final layout.

The following equipment also covered in the scope of erection / commissioning of Isolated Phase Busducts:

A. Shorting Bars

One set of shorting bar common for both the sets shall be supplied for generator dryout

B. SP & VT Cubicle, LA & VT cubicle

SP & VT Cubicle shall be of draw out type with VT mounted on trolleys, fabricated out of 3 mm thick steel sheet, complete with illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. The cubicle shall be self-supporting type. Each set shall comprise of the following:

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i. NG Cubicle

NG Cubicle shall be fabricated out of 3 mm thick steel sheet complete with illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. The cubicle shall be self-supporting type and degree of protection shall be IP54/IP23. Each set shall house the following:

i. Dry type epoxy cast NG transformer 1 No.

ii. NG Resistor

C. Busduct Supporting Structure

Busduct supporting structure shall be fabricated from standard steel sections welded / bolted and hot dip galvanized. All structure hardware shall be HTS hot dipped / electro-galvanized.

Approximate Weight of structure: 65MT for each unit.

D. Air Pressurisation equipments

The generator bus duct will be provided with positive air pressurizing system comprising 2 x 100% capacity air compressors with necessary filters, driers, piping, valves, drains, pressure switches / gauges, fittings and necessary controls. A control cabinet shall be furnished with control and monitoring devices such as motor starters, indicating lights, push buttons, etc. with provision for remote alarm.

1.13.3.3 SEGREGATED PHASE BUSDUCTS

General Description

Segregated phase busduct shall be supplied complete with AL alloy enclosure and conductor, AL alloy barrier, single porcelain bus support insulator arrangement, rubber bellows, inspection windows etc. All bolted joints shall have high tensile steel hardware which shall be cadmium plated / zinc plated and passivated. All conductor bolted joints shall be silver plated. SP HT Busducts shall be connected to Standby Transformer, Unit Transformer, Unit Auxiliary Transformer and 11/3.3 KV Switchgear.

The details are as given below:

Busduct Conductor

Material	: Al. Alloy Gr 63401
Shape and cross section	: Box channel; 2374 sq mm
Size	: 2 x 127.2 x 48.0 x 8 TK.

Busduct Enclosure

Material	: Al alloy Gr 31000
Shape	: Rectangular
Size	: 1350 x 450 (11 KV) 1200 x 400 (3.3 KV)

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Thickness : 3.15 mm

Barrier thickness : 2 TK

Approx. wt. of seal off bushing: 15 kg (11 KV), 10 kg (3.3 KV)

Average weight of busduct : 90 Kg / Mtr

The following equipments are covered in the scope of erection / commissioning of segregated phase Busducts:

- a. 11KV, 3150 A, Segregated Phase Busduct from 50 MVA unit transformer-2BBT01 to 11KV 2BB Switchboard
- b. 11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-2BAT01 to 11KV Switchboard 2BA
- c. 11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-1BBT01 to 11KV Switchboard 1BB
- d. 11KV, 3150 A, Segregated Phase Busduct from 50MVA unit transformer-1BAT01 to 11KV Switchboard 1BA
- e. 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 1BA
- f. 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 1BB
- g. 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 2BA
- h. 11 KV,3150A, Segregated Phase Tie Busduct from Standby SWBD-OBA to 11KV Unit Board 2BB
- i. 11KV, 3150A, Segregated Phase Busduct from 50MVA Standby TR. 0BAT01 to Stand By switch board 0BA
- j. 3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 1CAT01 to 3.3 KV Unit Board 1CA
- k. 3.3KV, 3150A, Segregated Phase Busduct from 16 MVA Unit Aux. Transformer 1CAT02 to 3.3 KV Unit Board 1CA
- l. 3.3KV, 3150A, Segregated Phase Bus duct from 16 MVA Unit Aux. Transformer 2CAT01 to 3.3 KV Unit Board 2CA
- m. 3.3KV, 3150A, Segregated Phase Bus duct from 16 MVA Unit Aux. Transformer 2CAT02 to 3.3 KV Unit Board 2CA
- n. 3.3KV, 630A Segregated Phase Bus duct from 3.5 MVA Plant Water Aux. Transformer 0CAT01 to Plant Water Aux. switch board 0CA
- o. 3.3KV, 630A Segregated Phase Bus duct from 3.5 MVA Plant Water Aux. Transformer 0CAT02 to Plant Water Aux. switch board 0CA

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- p. 3.3KV, 630A Segregated Phase Bus duct from 3.5 MVA AHP Aux. Transformer OCBT01 to AHP Aux. Switchboard OCB
- q. 3.3KV, 630A Segregated Phase Bus duct from 3.5 MVA AHP Aux. Transformer OCBT02 to AHP Aux. Switchboard OCB

1.13.3.4 BUSDUCT SUPPORTING STRUCTURE:

Each set of bus duct supports is supplied with hot dip galvanized / standard steel sections supporting structure and shall be erected as per drawings. The approximate Weight of structure will be 62 MT for both units. Any additional supports if required shall be fabricated and erected at site. The required material shall be supplied by BHEL free of cost and the further processing like fabrication, cold galvanizing / zinc phosphate painting, erection shall be carried out by the contractor without any extra cost.

The rate quoted by the bidder for the bus duct shall be inclusive of the above referred supporting structure works. The bidder may take care of this while quoting his price.

1.13.3.5 SCOPE OF WORKS FOR ERECTION & COMMISSIONING OF BUSDUCTS

The general scope of works for Isolated / Segregated Phase Bus duct is as below.

Receipt from BHEL stores / yards, unloading all the bus duct materials and accessories and equipment as indicated in the BOM and enclosed relevant drawings that forms the part of the tender specification, at the area where the bus ducts are to be erected, inspection, installation of all the materials, testing and commissioning of total bus duct items, painting and handing over.

Dimensions & weights indicated in the specification / BOM indicated for isolated / segregated phase bus ducts is only approximate. The relevant drawings are enclosed for the purpose of tendering. The contractor has to ascertain the quantum of work involved and quote the lump sum value as called for in the rate schedule.

There may be variations in the weight and dimensions. Any variation in the length of Busducts upto +20% as compared to actual length indicated in the BOM, shall not be considered for payment. However, for variations beyond +20%, payment shall be considered proportional to the length of the Busducts. Variations in width or height or weight including support structure shall not be considered for payment.

Detailed scope of work shall as below:

- a. Transport of Busducts and associated items and equipment from BHEL Stores to erection site. Cleaning of enclosure and conductors, insulators and other panels before assembly and erection.

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- b. Placement of embedment and erection and alignment of steel support structures.
- c. Assembly and checking of busduct at ground level if necessary.
- d. Fixing of wall bushings / wall frame assembly
- e. Providing earthing connections as per site conditions.
- f. Minor civil work such as chipping and drilling holes on concrete if necessary and grouting of busduct support structures including supply of materials required for civil works.
- g. Carrying out required level of cleaning inside as well as outside of the busduct for the purpose of conducting high voltage test before commissioning of the unit.
- h. Earthing as detailed in the relevant bus duct drawings.
- i. Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)
- j. Extension of embedment if required and erection of required supports structures as detailed in the drawing.
- k. Tightening of all bolts in the joints and flanges by calibrated torque wrench to the approved pressure (Anti oxidation compound will be used for joints which will be arranged by contractor)
- l. Conducting air-tightness test after erection to meet the requirement of BHEL / Customer Standards.
- m. Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, rotameter etc. at their cost. Contractors shall tap the air from nearest Instruments air tapping point available at site.
- n. Conducting high voltage test for IP/SP bus ducts, short circuit test for IP bus ducts and other tests as detailed in Section VII as per instruction of BHEL engineer after making necessary cleaning inside as well as outside of the bus duct & arranging all testing equipment required for carrying out bus duct testing. Each bus duct pieces will have to be tested for IR value and HV test at working voltage before erection.
- o. Fixing of Current transformers in bus ducts including wiring from CT terminal to junction box, taking through rigid/flexible conduit pipe.
- p. Fixing of Space Heaters on the busducts including wiring from Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe
- q. Fixing of Breather wherever required.
- r. Carrying out millivolt drop test is in contractors scope

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- s. Testing of all CTs, VTs as per BHEL's Field quality Plan
- t. Erection of GI conduit for space heaters, erection of JB's, wiring for space heaters, testing and commissioning shall be done.
- u. Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer VOLUME-IA PART – I CHAPTER – XVI (Painting). Name of the equipment shall be painted boldly as per the instruction of site engineer. Any danger boards required to be displayed shall be arranged by the contractor.
- v. BHEL will provide 75 / 18 Ton capacity cranes for the purpose of erection on sharing basis at free of cost. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.

1.13.3.6 SCOPE OF WORK SPECIFIC FOR ISOLATED PHASE BUS DUCTS:

- 1. Erection and commissioning of NG cubicle with all its accessories if supplied as loose.
- 2. Fixing of neutral side flexible connections to generator and position of neutral CTs after testing.
- 3. Assembly, erection, testing and commissioning of VT, SP & VT, NGT, NGR cubicles with its equipment such as lightning arrestors, voltage transformers, fuses, etc.
- 4. Erection and alignment of TEE OFF busducts for unit transformer, SP & VT cubicle etc.
- 5. Grouting of bus duct support structures.
- 6. Erection and commissioning of air pressurization equipment with all the accessories.
- 7. Carrying out aluminum welding for bus conductor and on enclosure as detailed in the drawing using MIG / TIG machine with the Aluminum filler wire as per BHEL specification.
- 8. Providing of MIG / TIG welding machine, aluminum filler wire, Argon gas of high purity and other required consumables as per BHEL standard for efficient aluminum welding, covering supporting insulators with asbestos cloth whenever aluminum welding is carried out near the supporting insulator.
- 9. Making necessary modifications of make up pieces, if required, and welding of isolated phase bus ducts along with NGT, SP & VT cubicle, UT tap-offs and delta connections.
- 10. Conducting 10% X-ray and 100% DPT test on all welded joints of conductor and enclosure and arranging the required radiographic and NDT equipment.

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11. Providing well-experienced Aluminium welder to meet the required quality.
12. Grouting the ground bus provided on the entire length of entire length of busducts, all parts of supporting structures and one end of each enclosure.
13. Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.
14. Arranging all T&P material handling equipment required for erection.
15. Calibration of all inspection, measuring and test equipment (IMTEs) before using.
16. Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.
17. Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL / TNEB Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
18. Maintaining the equipment after commissioning till taken over by TNEB
19. Other requirement for Erection / Commissioning of IP Busducts.
 - a- Aluminium welders shall appear for test as directed by the BHEL welding Engineer and only test qualified welders shall be permitted to do the welding.
 - b- For MIG / TIG welding only high purity argon gas shall be used. If the contractor is unable to arrange the required high purity Argon gas, the same shall be arranged by BHEL on chargeable basis. The cost of gas shall be recovered from the running bills as per BHEL norms.
 - c- Aluminium filler wire / rod shall be procured in consultation with BHEL Welding Engineer from approved Vendors of BHEL.
 - d- Make up pieces shall be supplied along with bus ducts. Necessary MIG / TIG welding of different sections of enclosures, make up pieces and bus will be carried out at site.
 - e- Holes on the flanges may not be adequate or may not match and any additional holes required same shall be drilled at site to facilitate matching of busduct enclosure flanges including generator flange.
 - f- BHEL will provide 18 Ton crane including EOT at free of cost. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.
 - g- Connecting the Busduct with other equipment erected by other agencies is in the scope of Busduct erection.
 - h- Any minor modification required in the bus conductor / enclosure of the bus duct for matching the switch gear in-comer and transformer adopted box shall be carried out without additional cost.

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1.13.4 GENERATOR CIRCUIT BREAKER

Generator circuit breaker of 21 KV, 3 pole beam / floor mounted SF6 Generator Circuit Breaker with loose supplied mounting frames / brackets, supports, individual pole breaker indication panels, centralising panel, series isolators, Surge capacitors and short circuit connect link, earthing switch etc including all associated accessories

Rated voltage - 24 KV

Rated continuous current - 21 kA

Total weight of circuit breaker - 7210 kg approx

Dimensions: 6719 mm x 3746 mm x 3457 mm

The supplier of generator circuit breaker will supervise the commissioning. Contractor will have to arrange all test equipments and carryout the commissioning. All necessary commissioning tests of Generator circuit breaker including contact resistance are to be carried out by contractor. Final painting shall be done as per spec and approval of BHEL.

1.13.5 SCOPE OF WORK FOR CABLES:

1.13.5.1 BHEL will supply HT and LT cables (armoured / unarmoured, Aluminium / Copper PVC FRLS insulation) and Instrumentation cables of different sizes and also Termination Kits / Jointing Kits for HT cables.

1.13.5.2 The scope of work includes laying & termination of cables, fixing of glands, ferrules, tag plates with necessary numbering and dressing of cable, as per BHEL specification and BHEL engineer's instructions. All the cables shall be identified at both ends, adjacent to the cable glands. In addition, cable shall be identified at all draw / pull pits, manholes, pull boxes, and at major changes of direction in cables tray / trenches and multilayer racking cable routes.

1.13.5.3 The unit rate for laying of HT cables shall also include fixing of Trefoil clamps and clamping as per BHEL specification.

1.13.5.4 Cable Termination

- Termination of HT cable shall be treated as part of installation of HT termination kits and no separate rate shall be applicable for the same.
- Separate rate shall be paid for termination of LT Power cables of Higher sizes. Such cables will be indicated in the BOM/ Rate Schedule.
- For all other cables, a composite rate covering laying and termination shall be applicable.

1.13.5.5 The rate quoted for termination shall include hipot testing after installing the termination kit.

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- 1.13.5.6 Unit rate quoted for cable shall cover laying, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required fixing of cable glands, fixing of glands, ferrules termination, and providing tag plates and dressing.
- 1.13.5.7 Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed in General GuideLines.
- 1.13.5.8 Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.
- 1.13.5.9 The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. For LT cable joining, if any, separate rate shall be considered on extra works basis.
- 1.13.5.10 The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.
- 1.13.5.11 Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
- 1.13.5.12 During testing and commissioning, if the equipment on which the cables are terminated not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling, The contractor shall promptly depute his supervisor or technicians to assist the commissioning agencies to check the interconnecting cables.
- 1.13.5.13 Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.
- 1.13.5.14 The approximate number of termination for the purpose of estimation to be assumed as follows: The average run length shall be considered as 150 Mtrs.
- 1.13.5.15 SCOPE OF CABLE TERMINATION
 - i) The scope of termination shall include termination of cables on various equipment installed by others.
 - ii) Re-termination if required during testing / commissioning, shall be carried out without additional cost.

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- iii) Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation.
- iv) Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.
- v) Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.
- vi) After cable terminations, the debris shall be removed then & there

1.13.6 SCOPE OF CALIBRATION:

Contractor has to calibrate all the instruments covered in their scope and maintain the calibration records as per the relevant FQP formats.

1.13.7 SCOPE OF WORK FOR FABRICATION OF STRUCTURAL STEEL MATERIALS:

- a. The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL.
- b. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.
- c. Any minor chipping as required as detailed in VOLUME-IA PART –I CHAPTER -XI, including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After installation of frames, supports the grouting of the same is in the scope of contractor.
- d. If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost.
- e. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting.
- f. A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.

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1.13.8 SCOPE OF CIVIL WORKS

In addition to the scope of works as detailed in VOLUME-IA PART –I CHAPTER –XI, the following scope of civil works shall be carried out by the bidder within the quoted price.

Minor civil works like drilling, chipping for transformer / bus duct foundations and punching & opening in concrete floors, slabs, brick walls, grouting of bus duct columns, base frame of panels, Transformer etc. including supply of cement, sand, concrete etc., cleaning of all debris due to electrical installation.

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VOLUME-IA PART – I CHAPTER - XIV PROGRESS OF WORK

The scope of the work will comprise of but not limited to the following:

1.14.0 PROGRESS AND MONITORING OF WORK

- 1.14.1 Refer forms F -14 to F-18 of volume I D of volume -I book-II. Plan and review will be done as per the formats.
- 1.14.2 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.
- 1.14.3 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.
- 1.14.4 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL's format.
- 1.14.5 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.14.6 The monthly report ending on 24th of every month shall be submitted as a booklet and shall contain the following details :-
 - a) Colour Progress photographs to accompany the report should be submitted.
 - b) Erection progress in terms of tonnage, welding joints, radiography, stress relieving, etc., completed as relevant to the respective work areas against planned.
 - c) Site Organization chart of engineers & supervisors as on 24th of the month with further mobilization plan
 - d) Category- wise man hours engaged during the previous month under the categories like fitters, electricians, welders, riggers, khalasis, grinder-men,

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gas-cutters, crane operators, store keepers, lab technicians, helpers security etc. Data will be spilt up under the work area of Boiler

- e) Consumables report giving consumption of all types of gases and electrodes during the previous month.
 - f) Availability report of cranes
 - g) Safety implementation report in the format
 - h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.
- 1.14.7 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
- 1.14.8 During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.
- 1.14.9 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding erection progress, labour availability, equipment deployment, testing, etc.
- 1.14.10 The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.
- 1.14.11 The contractor to reflect actual progress achieved during the month and will be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control will update the construction schedule forming part of this contract each month.

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VOLUME-IA PART - I CHAPTER- XV TESTING AND COMMISSIONING

The scope of the work will comprise of but not limited to the following:

1.15.1 SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:

1.15.1.1 Scope of pre-commissioning / commissioning starts with the commissioning of various equipment erected by the contractor and making them available to commission various materials / systems and main power plant. The scope of work of various commissioning activities of the main plants is referred below:

- a. Trial run of various equipment.
- b. Light up of boiler.
- c. Boiler acid cleaning.
- d. Boiler alkali boil out.
- e. Turbine barring gear.
- f. Steam blowing of piping.
- g. Turbine rolling.
- h. Safety valve floating.
- i. First synchronisation
- j. Heavy oil firing and synchronisation.
- k. Coal firing.
- l. Trial Operation / Full load.

The above activities, tests, trial runs may have to be repeated till satisfactory results are obtained and also to satisfy the requirements of customer / consultant / statutory authorities like boiler inspector, electrical inspector etc.

1.15.1.2 The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.

1.15.1.3 The pre-commissioning activities of the main power plant will start with energizing of start up power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by him to match with the various milestone activities /commissioning programme of the project. All these works need specialised testing engineers, supervisors including electricians in each area to co-ordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection work.

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- 1.15.1.4 The mobilization of testing team shall be planned in time and shall be undertaken round the clock. Contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost will be recovered from contractor.
- 1.15.1.5 Prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope
- 1.15.1.6 Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.
- 1.15.1.7 Minimum requirement of Man Power for testing/checking works shall be as follows:

	TRANSFORMER	BUS DUCT	HT SWITCHGEAR
Engineer	1		2
Supervisor	2	1	3
Technician	3	2	6

The above testing/checking group shall be identified at the Pre-commissioning time. The above commissioning group shall have the knowledge of various systems referred in the tender and possess adequate experience in testing. The above manpower for commissioning is only tentative and if any additional manpower required as per site requirement, the same shall be arranged by the contractor. If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, no payment shall be made against commissioning activities as per terms of payment.

- 1.15.1.8 All T&P / instruments required for testing including the Generator Circuit Breaker (21 KV) are to be arranged by the contractor.
- 1.15.1.9 All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.

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- 1.15.1.10 The scope of commissioning assistance to be provided by the contractor will cover the equipment / drives erected by the mechanical contractors as detailed in the BOM.
- 1.15.1.11 All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL/ its client free of hire charges. However contractor has to take proper care of the equipment issued to him.
- 1.15.1.12 All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.
- 1.15.1.13 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.
- 1.15.1.14 It shall be specifically noted that the contractor and employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers / customer officials. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers/supervisors.
- 1.15.1.15 In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost. If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.
- 1.15.1.16 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.
- 1.15.1.17 Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

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- 1.15.1.18 After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools and supervision as part commissioning assistance till handing over of sets to customer.
- 1.15.1.19 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.
- 1.15.1.20 The contractor shall carryout any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.
- 1.15.1.21 It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, even if commissioning of equipments is delayed due to reasons not attributable to the contractor.

1.15.2 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

1.15.2.1 All types of Drives and Generator

- a- Cable identification, checking and meggering.
- b- IR value of Generator, motor, measurement of winding resistance etc.
- c- Dryout all the motors if required to improve IR value.
- d- Checking direction of rotation of motors and testing and commissioning from local as well as remote.
- e- Checking the bushing and HV test / Tan delta test
- f- Attending to any defects till the handing over of the unit to customer

1.15.2.1 ESP Transformer

- a- Dry out of transformers (Oil filtration) till achieving desired BDV, IR Value, Calibration of oil temperature gauges, checking of breather gauge, Relays, HV Test etc. i.e. scope of commissioning of ESP Transformer shall be in line with transformers erected by the contractor.
- b- Replacing defective components like temperature gauges, breather glass etc.
- c- Attending to any defects till handing over of the unit to customer by BHEL.

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VOLUME-IA PART- I CHAPTER-XVI PAINTING

The scope of the work will comprise of but not limited to the following:

1.16.0 FINAL PAINTING

- 1.16.1 The quoted rate / price shall be inclusive of supply and application of final painting of all the erected equipments like all steel items such as supports, racks, frames, Transformer, Bus ducts, as per the painting specifications of customer / BHEL.
- 1.16.2 In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.
- 1.16.3 All the exposed metal parts of the equipments including busducts, transformers, structures, etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL / Customer official.
- 1.16.4 Normally Paint shall be applied by brushing as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimum. If needed and insisted either by BHEL / Customer in certain cases, spray painting has to be carried out within the Quoted rates. Spray painting gun and compressed air arrangement has to be made by the contractor himself within the Quoted rates.
- 1.16.5 All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.
- 1.16.6 Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.,
- 1.16.7 The scope of painting includes application of colour bands, lettering the names of the systems equipments; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.
- 1.16.8 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

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- 1.16.9 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification / relevant BHEL document/ customer's specifications.
- 1.16.10 The actual colour to be applied shall be approved by the customer before starting of actual painting work.
- 1.16.11 Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities.
- 1.16.12 No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.
- 1.16.13 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
- 1.16.14 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL/ Customer.
- 1.16.15 PRESERVATION / TOUCH UP PAINTING
 - 1.16.15.1 Contractor shall carryout cleaning and preservation / touch up painting for the materials / equipments under this tender specification right from pre- assembly stage to till the equipment is cleared for final painting within the quoted rate.
 - 1.16.15.2 Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with touch up coat of red oxide primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.
 - 1.16.15.3 Mostly the equipment / items / components will be supplied with one coat of primer paint and one coat of finish paint. However during storage and handling, the same may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour.
 - 1.16.15.4 Touch up painting only is generally required for control panels, and full painting shall be required only for specific equipment such as Busducts, Transformer etc. as per the scope of erection.

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VOLUME-IA PART – II CHAPTER - 1 REVERSE AUCTION PROCEDURE

GENERAL TERMS AND CONDITIONS OF REVERSE AUCTION

Against this NIT for the subject work, tender shall be processed through “REVERSE AUCTION PROCEDURE” i.e. ON LINE BIDDING on INTERNET.

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on Internet.
3. BHEL will inform the vendor in writing in case reverse auction, the details of service provider to enable them to contact and get trained.
4. Business rules like event date, time, start price, bid decrement, extensions, etc. also will be communicated through service provider for compliance.
5. Vendors have to fax the compliance form in the prescribed (provided by service provider) before start of Reverse auction. Without this the vendor will not be eligible to participate in the event.
6. BHEL will provide the calculation sheet (e.g.: EXCEL sheet) which will help to arrive at “Total Cost to BHEL”.
7. Reverse auction will be conducted on schedule date & time.
8. At the end of reverse auction event, the lowest bidder value will be known on the network.
9. The lowest bidder has to fax the duly signed filled-in prescribed format as provided on case-to-case basis to BHEL through service provider within 24 hours of action without fail.
10. During Reverse Auction, the process of reverse auction is unsuccessful then BHEL at its discretion may decide to call the L1 bidder of reverse auction for further negotiation.
11. Sealed bid reverse auction: The opening bid (in the initial auction) of the bidders shall be same as that quoted in their final sealed price submitted to BHEL. The bidder shall confirm in writing to BHEL that their opening bid in both cases shall be same as that quoted in their final sealed price bids submitted to BHEL against this NIT along with Technical bid.
12. BHEL reserves the right to cancel Reverse Auction (RA) without assigning any reasons and resort to considering the sealed bids submitted by vendor for processing and finalizing the tender.

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13. Any variation between the on-line bid value and signed document will be considered as sabotaging the tender process and will invite disqualification of vender to conduct business with BHEL as per prevailing procedure.
14. In case BHEL decides not to go for Reverse auction procedure for this tender enquiry, the price bids and price impacts, if any already submitted and available with BHEL shall be opened as per BHEL standard practice.
15. Bids given by the bidders during the reverse auction process will be taken as an offer to execute the work. Bids once made by the bidder, cannot be cancelled/withdrawn and bidders shall be bound to execute the work as mentioned above at the final bid price. BHEL shall take appropriate action as the lowest bidder do not execute the contract as per the rates quoted by him.

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VOLUME-IA PART- II CHAPTER -2

TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING, COMMISSIONING AND SUPPLY ITEMS OF HT / LT ELECTRICAL PACKAGES

2.2.1 INSTALLATION, TESTING & COMMISSIONING IN GENERAL:

The stages of completion of various works shall be as follows:

Completion

- Equipment shall be considered to be completely erected when the following activities have been completed.
- Moving of all equipment to the respective foundations.
- Fixing of anchor bolts or tack welding as required.
- Leveling and alignment of equipment.
- Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification.
- Cable laying, termination with continuity check.
- Applying of finishing coat of paint.

All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The site tests and acceptance tests to be performed by contractor are detailed below.

The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

2.2.2 SITE TESTS AND CHECKS

2.2.3.1 General

All the equipment shall be tested at site to know their condition and to prove suitability for required performance.

The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site.

In addition to tests on individual equipment some tests / checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalized with consultation of client before charging of the system.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

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All checks and tests shall be conducted in the presence of client's representative and test results shall be submitted in six copies to client and one copy to Electrical Inspector. Test results shall be filled in proper proforma.

After clearance from Electrical Inspector system/equipment shall be charged in step by step method.

Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging are to be brought by the contractor.

2.2.3.2 Trial Run Test

After the successful test of each equipment as per standard test procedure the entire control system shall be put on trial run test on actual site conditions and operation of the system.

2.2.3.3 Acceptance Test

The acceptance test on the system shall be carried out by the supplier as per mutually agreed test procedures to establish satisfactorily functioning of the system as a whole and each equipment as part of the system.

2.2.3 BUSDUCTS – ISOLATED / SEGREGATED PHASE BUSDUCTS

2.2.3.1 HANDLING AND STORAGE

General

Busduct form the main electrical connections between the Generator and associated generator transformer and tap-off to UAT, VT & SP cubicle and GCB. The ducts are made of aluminium sheet which house the busbar conductors supported on post insulators. The duct assembled are suitably supported on the structures in the station. The bus enclosure assembled are despatched with the insulators assembled and the conductor are sent either loose or assembled inside the duct, keeping in view the erection necessities and transport limitations.

2.2.3.2 INSPECTION AT SITE :

When the packages are received at site, these must be checked for the following:

- a. Completeness and correctness of the consignment. (Compare with delivery documents)
- b. Physical damage if any during transit.

2.2.3.3 HANDLING DURING ERECTION :

The busducts are in unpacked conditions, therefore, great care is necessary in handling. Ensure that:

- a. While lifting enclosure assemblies manila ropes are passed round the busduct enclosure near the support channels.

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- b. All shipping steel clamps are to be tightened and busbars do not slip out while handling, if the busbar is assembled in the enclosure.
- c. While inserting and mounting the busbar in the enclosure care is taken that the busbar does not hit and damage the insulators.
- d. Eye bolts are used while lifting the cubicles.

On completion of 2.2.3.3, items must be returned to original packing cases unless required for immediate erection.

2.2.3.4 Caution

- 1. When inspecting the enclosures assemblies etc. the wooden packings, braces and polythene covers should be replaced, if removed, to prevent damage and ingress of duct and moisture.
- 2. Aluminium being softer material, great care must be taken in handling enclosures and other aluminum items.
- 3. If the site conditions make it impossible to return the items to the cases for storage:
 - a. Nothing must be laid direct on the ground.
 - b. All items must be protected against weather and damages.

2.2.3.5 HANDLING OF BUS DUCT.

Handling from delivery station to power station stores:

- 1. Use suitable slings to lift the packages
- 2. No impact should come on the packings while loading. Do not drop from height.
- 3. Do not stack busduct packings one above the other; also avoid stacking of heavier items on busduct packings.

2.2.3.6 DURING UNPACKING, HANDLING AND STORAGE

DO's

- 1. Check all the packings for any damage during transit.
- 2. Open the packings carefully.
- 3. Verify material as per shipping list and report any shortage/damage immediately.
- 4. Keep material in original packings unless required for erection.
- 5. Ensure that Manila ropes are used for lifting the busduct.
- 6. Check the tightness of shipping steel clamps while lifting busduct assembly with busbar in position.

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7. Ensure that CTs, LAs, capacitors, N.G. transformer, grounding resistor, fuses, insulators, wall bushings, moulded and rubber items and flexibles are stored in well ventilated area.

DON'Ts

1. Don't destroy any markings.
2. Don't drop packings from height.
3. Don't stack heavier items on busduct packings.
4. Don't keep door of cubicle open during storage.
5. Don't lay down unpacked material directly on the ground.
6. Don't cause damage or scratches by dropping, dragging etc. on fragile items such as CTs, PTs, Insulators, rubber items etc.

2.2.3.7 DURING ERECTION & COMMISSIONING :

DO's

1. Carry out pre-lay survey to verify the position of various equipment to be connected, levels of floors and positions of cutouts.
2. Keep the layout drawing etc. ready for reference.
3. Draw the material from stores as per erection sequence.
4. Ensure alignment and proper matching of various enclosures and busbars.
5. Ensure proper alignments of epoxy cast CTs and seal-off bushings before final tightening of hardware.
6. Make the busbar joints as per the instructions.
7. Ensure aluminium welding by qualified welder only.
8. Take care for proper sealing while joining the enclosure.
9. Ensure proper earthing of enclosure and structure as specified.
10. Check wiring as per relevant wiring diagram.
11. Ensure that CT secondaries are shorted and grounded before HV test on busduct.
12. Ensure that HV test at rated voltage is carried out for IP bus ducts before erection and IR value for all sections of SP and NSPB bus ducts

DON'Ts

1. Don't allow accumulation of dirt or foreign material inside the enclosure during erection.
2. Don't overtighten the bolts.

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3. Don't hammer the bolts etc. while joining the busbars if holes are not matching.
4. Don't forget any foreign material inside the enclosure.
5. Don't allow aluminium welding by unqualified welder.
6. Don't subject IAS, capacitors, and PTs to HT test as these are pre-tested and test at site is not required.
7. Don't subject NG transformers to over voltage as these are pre-tested.
8. Don't apply rated voltage to full bus duct unless pre commissioning checks are completed.
9. Don't apply any voltage to bus ducts when the ends are connected to equipments like transformer and generator.
10. Don't apply high voltage with surge arrestor and lightning arrestors in circuit.

2.2.3.8 ERECTION INSTRUCTIONS

A. Packing and Shipping

Layout drawing and main bill of material (M.B.O.M) or shipping list should be referred to for identification of various items. All the drawings necessary for assembly and erection are furnished separately.

IP Busducts are usually despatched as single phase assemblies generally assembled with busbars. The busbars are braced with steel clamps to avoid any damage to insulators and displacement of busbars during transport. Structures, hardwares, flexibles, and other miscellaneous items are packed separately.

B. Marking :

Following markings are done with paint on busduct assemblies and cubicles for identification :

- a. Project name and unit number
- b. Item no of main BOM this is encircled
- c. Phase marking R, Y or B
- d. Work order number
- e. Drawing number and item/variant number
- f. Arrow indicating direction towards transformers end. Direction of arrow shall be decided from lay out.

C. Similarly loose items are also identified by suitable marking on tags.

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2.2.3.9 PRE LAYOUT SURVEY

Before starting the erection work the centre lines of the complete busduct installation, location of connected equipment such as main transformer, unit auxiliary transformer, VT & SP cubicle, NG Cubicle etc. with respect to generator central line should be established and marked clearly. The various levels of floor, ceiling, terminal position of main transformer, unit auxiliary transformer etc. should also be verified. Any deviations in this regard should be recorded and necessary remedial measures should be taken. In case of any substantial deviation which may effect the erection of busduct installation, the same should be referred to the design engineer. The remedial measures should be planned in advance, which may consist of levelling by suitable packers chipping of the concrete floor or wall etc. or rectification of the components with the concurrence of engineers.

2.2.3.10 PROVISION OF FOUNDATION BOLTS & EMBEDDED ITEM

In the power station, busduct is supported on various floors, halls, ceiling, etc. and support structure is suitably attached to the building. For this foundation bolts, embedded items are grouted at number of locations as per foundation drawing.

2.2.3.11 SEQUENCE OF ERECTION

Normally the following sequence of erection is recommended.

A. Erection of steel work :

First, all the vertical structures are to be installed, leveled and foundation bolts grouted. Next, place all the longitudinal cross channels in position, adjust the level and bolt / weld them.

Check up the correctness of levels and positions of various installed structures. For installation of foundation bolts refer foundation details drawing of the project.

B. Erection of Enclosures :

Before the installation of enclosures in position each assembly of enclosure and conductor complete with insulator supports is to be checked for correctness and cleaned on the working floor.

The various enclosures assembled are to be erected as per layout drawing. After placing the assemblies in position the packing braces/steel clamps inside the ducts are to be removed.

Some of the busduct assemblies will be self supporting only when they are welded to adjacent enclosures, as such some temporary scaffolding is necessary to support these enclosures during erection, leveling and welding.

C. Handling of Busducts :

For handling of busducts specified instructions should be followed.

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D. Sequence of erection-enclosure assemblies:

In positioning the various enclosures assemblies the following sequence is recommended:

E. Indoor Portion:

(a) Neutral Side

Complete the assembly of top chamber/neutral shorting chamber at the working floor as per the drawing. Connect copper flexible on the generator neutral terminals, and fix it with the generator plate. Provide temporary support as necessary. Complete the assembly of bottom chamber (if applicable) along with CTs and wiring as per drawing at the working floor and match with the top chamber (if applicable). Now fix the supporting structure. Assemble N.G. Transformer and N.G. Reactor and complete the terminal connections.

Note: Before fixing top chamber / bottom chamber, care should be taken that shunts are welded on line side busduct as shown in lay out drawing :

(b) Line Side

Assemble copper flexibles and connections with generator line terminals. Match each phase generator enclosure with generator plate and fix to the support structure. Complete the generator terminal bolted connections.

Place P.T cubicle in position match and connect with the respective tap off.

F. Outdoor Portion :

Position the wall frame at the power house wall, place the wall duct and inset the rubber sealing ring over the enclosure. Complete the wall frame assembly.

Place the remaining enclosures on the structure starting from the wall duct and complete the main run to generator transformer. From main run tap-off enclosures are to be connected to unit auxiliary transformers, accommodating current transformers, flexible connection, disconnecting link and rubber bellows.

The alignment and exact locations of ducts may be verified before proceeding for making the assemblies of make-up piece rubber bellows, wall frame and bolted/welded joints of conductor and enclosures.

G. Busbar Joints :

Busbar joints may be bolted type or welded type as specified for the installation. For making the busbar joints, it is essential that specified procedures and precautions are followed.

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H. Cleaning of Busduct

Before putting the split covers, enclosures make up pieces (welded to enclosure) & covers of inspection windows, all the insulator should be cleaned again. The busduct should also be cleaned and dried up for any moisture/condensates. Thoroughly check the interior of every enclosures and ensure that these are free from any foreign matter.

I. Inspection of windows, covers, etc.

Finally, the split covers, inspection windows and make-up piece may be assembled. The assembly of split cover, inspection windows and make-up pieces should be done as per recommended procedures and it should be ensured that proper sealing is achieved.

2.2.3.12 BUSBAR BOLTED JOINTS

A. Aluminium to Aluminium Joints (Un plated)

Wipe the contact surfaces with dry clean cloth to remove any dirt, dust and moisture and smear these with recommended jointing compound. Clean the surfaces under the compound by breaching with dry coarse emery cloth or stainless steel wire brush. Wipe the surfaces with a clean dry cloth and immediately make a light application of jointing compound. Close up the joints and wipe off excess compound.

B. Aluminium to Copper Joints :

Cleaning of Aluminium surface (Unplated)

Follow Instructions given under clause 2.2.3.12 A above and apply jointing compound.

Cleaning of copper surfaces (unplated)

Clean the copper contact surface with emery cloth and wipe the surface with clean dry cloth.

Cleaning of copper aluminium surfaces (unplated)

Clean the contact surface with dry cloth to remove dirt, dust and moisture. Apply a light coating of jointing compound.

C. Aluminium to Copper Joints using bimetallic strip

For cleaning of aluminium and copper surfaces follow instructions given under 2.2.3.12 A&B above. Apply jointing compound to aluminium and copper surfaces.

The contact faces of bimetallic strip should also be cleaned as per the above practice and jointing compound applied.

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Note : Bimetallic strip is inserted between the copper and aluminium surfaces.
Care should be taken that copper faces copper surface and aluminium faces aluminium surface.

D. Cleaning of copper surfaces (plated)

Clean the contact surface with dry cloth to remove dirt, dust and moisture.

Note: Wire, brush, emery cloth or jointing compound containing metallic particles or other abrasives should not be used on plated surfaces.

2.2.3.13 CONTACT PRESSURE

To obtain correct tightening pressure on contact surfaces following torques are recommended for various bolt sizes.

Bolt Size	Recommended Torque	torque Spanner Capacity
M10	0.85 to 1.3 NM (20-30 Ft-lb)	0.85 to 1.3 NM (20-30 Ft-lb)
M12	1.3 NM to 1.7 NM (30-40 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)
M16	1.7 to 2.1 NM (40-50 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)
M20	2.1 to 2.5 NM (50-60 Ft-lb)	0.85 to 4.3 NM (20-100 Ft-lb)

Alternatively tighten the nut till belleville washer becomes flat. Then unscrew the nut by about 1/8 th. turn.

2.2.3.14 RECOMMENDATION FOR WELDED JOINTS

A. Circumferential weld circular section :

A FULLY penetrated; fully fused welded with a 10%T (4mm max) reinforcement is required.

Welding conditions M.I.G. Process

Filler wire	:	1.6mm dia (NG 21 with 5% silicon)
Angle	:	10° to 15° Forehand
Cleaning	:	Decrease and scratch brush
Setting	:	250A to 320A, 28 to 30 Volts (Dependent on tk)
Process	:	4 off 25mm long equispaced tack welds
Gas supply	:	50 Cu. ft/hr argon – 10-12 Lits/Min.Argon
Shield	:	5/8" dia
Purity	:	99.98%

B. Tubular Conductors :

Tubular Conductors are used in tee-off connections.

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Welding conditions M.I.G. Process

Filler wire	:	1.6 mm dia (NG 21 with 5% silicon)
Angle	:	10° to 15° Forehand
Cleaning	:	Degrease and scratch brush
Setting	:	215A to 275A, 22 to 2 Volts
Gas supply	:	50 Cu. ft/hr argon
Shield	:	5/8" dia
Purity	:	99.98%

C. Enclosures

Fillet weld for make up pieces/shunts. Tack weld at four places.

Welding conditions M.I.G. Process :

Filler wire	:	1.6mm dia (NG 21 with 5% silicon)
Angle	:	10° to 15° Forehand
Cleaning	:	Degrease and scratch brush
Setting	:	200A to 300A, 25 to 30 Volts (Dependent on thickness)
Gas supply	:	50 Cu. ft/hr argon
Shield	:	5/8" dia
Purity	:	99.98%

D. Drain valve and welding :

Owing to the dissimilar thickness used for this fillet weld, the arc must be directed into the pad only and not allowed to melt away and enclosure.

2.2.4.1 WELDED BUS ENCLOSURE JOINTS

Bridge the gap between the bus enclosure by means of make up pieces and clean the area by paint removed which is to be welded. Tack weld the make up pieces before final filled weld all around.

2.2.4.2 WELDED JOINTS OF SHUNTS

Various locations of shunts to be welded to the enclosures are shown in layout drawing.

2.2.4.3 DRAIN VALVE WELDING (IF APPLICABLE)

Mark the location as per lay out and drill 10mm dia hole at the bottom most point of enclosure. Tack weld the drain valve pad to enclosure ensuring proper alignment of pad hole with enclosure hole. Weld continuously as per jointing recommendations. Clean with wire brush and point for final finish.

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2.2.4.4 FIXING OF NEOPRENE SEAL :

Enclosures are fitted with access covers. Each cover is fitted with four pieces of neoprene seal and held in position by bolted clamps.

(Note: Only one cover should be removed from enclosure at any time to minimise the air flow into the enclosure).

2.2.4.5 EARTHING OF ISOLATED / SEGREGATED PHASE BUSDUCT AND CUBICLES

A. General

One end of the electrical continuous enclosure should be earthed to station earth at the shunt location where all the three enclosures are shorted. Location of earth points are shown in the layout drawing. For this purpose two drillings are to be done on these shunt to suit at site and two separate earth strap are to be connected to the station earth thus ensuring double earthing.

In some assemblies (such as transformer hood etc) due to short length of enclosures shunts are not provided. In such cases, each phase enclosure should be separately earthed.

One point of the earth phase split cover, rubber bellow clamping strap should be electrically connected to enclosures and in turn enclosures should be earthed.

B. Cubicle earthing :

Each cubicle is provided with two number of earthing terminals. These terminals are generally located on side face of the cubicle. Both the terminals are to be connected independently to the station earth by suitable connectors.

For earthing the top and bottom C.T. chambers, station earth can be connected to each chambers of two locations for double earthing.

2.2.4.6 SITE TESTS ON ISOLATED /SEGREGATED PHASE BUSDUCT

A. Physical Checks :

Design survey which include dimensional checking of electrical clearances and cleanliness of the installation.

B. Cleanliness :

The inside of all enclosures, outside of conductors and insulators should be free from dirt, all, grease, swaft and any deposits, special attention should be paid to the insulators and seal off bushings and oil moisture is to be removed and surfaces polished with a dry soft clutch. All panels/inspection windows cover are to be replaced after cleaning operation.

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C. Power Frequency High Voltage Test

Preparation :

Following equipment must be disconnected from busbars removing the bolted link and grounded suitably prior to conducting this test :

- a. Generator terminals
- b. Unit auxiliary transformer terminals
- c. Generator transformer terminals
- d. Neutral grounding transformer HV terminal
- e. Lightning arresters
- f. Capacitors
- g. Potential transformer.

It is important to ensure that secondary of all the current transformers mounted on busbars are shorted and grounded properly before conducting this test.

Ensure that all insulators seal-off bushings are cleaned free from any dust, grease and moisture etc before test.

During the test, ensure the following

- a. The generator rotor is kept stationary
- b. H.V. Circuit breakers on system side are kept in the open position.

D. Test Voltage:

The test voltage shall be attenuating current on any frequency between 25 hertz to 100 Hz and approximately of sine-wave form. The r.m.s. value shall be as given in table-1 below:

For A.C. voltage duration of test shall be one minute.

The test with D.C. at a voltage not in excess of the values given in Table-1, Column-3 for the corresponding rated voltage may be substituted for the AC test prescribed.

Table - 1

Rated Highest System Voltage	Test Voltage (A.C.)	Test Voltage (D.C.)
Upto & Including	KV	
3.6	16.8	
7.2	21.6	
12	28	
24	44	
36	60	

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E. Meggar-Checks:

Before the application of high voltage, check the insulation of each bus, conductors by means of 2.5 KV meggar. A value e. 100 mega ohms is expected under normal conditions. However, during mainly season this value may fall down considerably and drying up by hot air may be necessary before the test. Minimum acceptable value is around 20 mega ohms. After the application of high voltage the insulation value is checked gain.

F. Application of Test Voltage:

Corresponding test voltage as indicated in Table-1 shall be applied in turn between each phase conductor and its enclosure which shall be kept at ground potential. Remaining two phase conductors and their enclosure shall be properly as in consistent with its value being indicated by the measuring instrument. The full test voltage shall be then maintained for specified duration. Each bus including tap-off must withstand the above test voltage.

2.2.4.7 SITE TEST RECORDS ON ISOLATED PHASE / SEGREGATED PHASE BUSDUCTS :

Test conducted on date..... Site

Power Frequency high voltage test :

Instrument

Phase	Megger Reading before HV test	Megger Reading after HV test	HV applied & duration A.C./D.C.	Leakage current	Remarks
R					
Y					
B					

2.2.4 TRANSFORMER

2.2.4.1 INSTALLATION

To ensure that a Transformer will function satisfactorily, it is important that handling, lifting, storing and assembling are carried out with great care and cleanliness by experienced personnel who know the various working operations very well.

2.2.4.2 INSPECTION

In connection with receiving and unloading at site, and at the final storing place before assembling, the transformers shall be inspected carefully. External visible damages as dents, paint damage etc. may imply that the transformer has been subjected to careless handling during transport and/or re-loading, and a careful investigation is therefore justified.

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After the arrival of the material at receiving points, before unloading, the condition of packing and of the visible parts should be checked and possible traces of leaks verified (condenser bushing). If necessary, appropriate statements and claims should be made.

Drums containing oil which have separately despatched should be examined carefully for leaks or any sign of tampering. All despatched drums are filled upto their capacity and any shortage should be reported.

Check immediately the gas pressure at the arrival. A positive indicates that the tank and the transformer components respectively are tight, and that the active part including the insulation materials is dry.

If there is no positive gas-pressure, transformer should be immediately filled with dry Nitrogen gas at a pressure of 0.17 kg/cm² (2.5 psi) without loss of time.

Otherwise, it should be checked if the core isolation is satisfactory and that accessories packed separately have not been damaged during transportation.

2.2.4.3 UNLOADING

Whenever rollers/trolleys are supplied with transformer, movement of transformer at site is carried out by mounting these rollers / trolleys.

Alternatively for movement of transformer from loading bay to actual site of the equipment, skidding on greased rails etc can also be resorted to.

2.2.4.4 STORING

Dismantled equipment and components are packed to the protected against normal handling and transport stresses. The instructions for lifting given on the packages, must be complied with to avoid damages.

Goods stored outdoors must not be placed directly on the ground, and should be covered carefully with tarpaulin or similar materials.

Oil drum should be stored in horizontal (lying) position with both the bungs also in horizontal position.

2.2.4.5 LIFTING

Lifting devices on the transformer tank are dimensioned of lifting of the complete transformer filled with oil. The positioning of the lifting devices, permissible lifting angles, minimum height to crane hook and transformer weight, appear from the OGA drawings. Check at lifting of complete transformer that the lifting wires/ropes are not in contact with bushing or other components on the cover.

For lifting with hydraulic jacks, the transformer is provided with jacking pads dimensioned for lifting of complete transformer filled with oil. The position of the pads appear on the OGA drawings.

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2.2.4.6 CHECK POINTS BEFORE STARTING AND DURING ERECTION

a. Check points before starting erection.

1. Conditions of leads
2. Bracing, clamping of leads
3. Connections
4. Tap changer checks
5. General conditions of insulation
6. Core check that it has not moved in transit.
7. Core-ground; this is checked with the megger after removing earth connection
8. CTs, including the secondary leads and their passage through metal parts
9. Check that shipping frame for bushings have been removed.
10. Check that coil position has not moved in transit
11. Check for dirt, metal swarf, moisture
12. Check that the bushing leads set without being too close to ground or other points of different potential.

b. Check-points during erection:

By means of the part list and the transformer/reactor OGA, the assembling of a fully completed transformer is carried out according to the following instructions. The following precautions are to be taken:

- i. Fire-fighting equipment shall be available at the oil-treatment equipment as well as at work on and adjacent to the transformer.
- ii. Welding work on or adjacent to the transformer shall be avoided, but if this is not possible, the work shall be supervised by fire-protection personnel.
- iii. Smoking on or near the transformer shall not be allowed.
- iv. Transformer tank, control cabinet etc, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station
- v. Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened.
- vi. All loose objects, tools, screws, nuts etc. shall be removed from the transformer cover before opening the connection and blanking lids.
- vii. All loose objects (tools, pencils, spectacles etc.) shall be removed from the boiler- suit pockets etc. before starting the work through man-holes.

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- viii. Tools to be used inside the transformer e.g. for tightening of screws-joint-shall be fastened to the wrist or another fixed point by means of cotton tape or string.
- ix. Tools with loose sleeves and tools with catches must not be used at work inside the transformer.
- x. Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer.
- xi. Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it.
- xii. All components despatched separately should be cleaned inside and outside before being fitted.
- xiii. A Transformer is best protected from damp hazard by circulating warm, dry, de-aerated oil through it until its temperature is 5 C to 10 C above ambient. This should be done before allowing external access to the interior of the tank. The warm oil should be circulated all the time transformer is open to atmosphere.
- xiv. Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints.
- xv. The active part (core and winding) should be exposed to the surrounding air as short time as possible. Open therefore only one blanking plate or connection lid at a time for remounting of bushing, valves etc.
- xvi. Objects which-despite all precaution are dropped inside transformer / reactor, must absolutely be brought up from the equipment.
- xvii. Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.

2.2.4.7 ASSEMBLY

Assembly of wheels Bushing Valves, cooling device, Oil conservator, Pilot Flanges, Blanking plates and accessories like cooling fans, pumps, OLTC and components for supervision and control oil level indicator, flow indicators, gauges, Buchholz relay, PRV, thermometers etc. are assembled according to leaflet / description valid for the components.

2.2.4.8 OIL FILLING

The following procedure is recommended.

- i. Close and blank the valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum upto Buchholz level as per instructions given else where.
- ii. After filling the oil in transformer and breaking the vacuum, oil can be filled in the conservator either through reactor or by drain valve.

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- iii. Remove the inspection cover (ii) provided on the side of the conservator and check the air cell assuring that it is inflated. The air must remain in fully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry air / nitrogen gas to 0.035 kg/sq.cm max. A gauge may be put by removing plug. After filling close these connections.
- iv. Remove air release plugs provided on top of the conservator.
- v. Slowly pump the oil through main reactor / drain valve. Temporarily stop filling operation when oil starts coming from opening after ensuring that no air bubbles come out through these air release holes. Fit the two air release plugs.
- vi. Continue oil filling till oil start coming from air release plug stop oil after ensuring that no air bubbles come out. Fit the plug.
- vii. Now release the air pressure held inside the air cell from point and continue oil filling until magnetic oil gauge indicates 35 deg. C level.
- viii. Remove oil pump and connect air cell to breather from point. Also remove pressure gauge and put plug.
- ix. The system is now properly filled. Air release plugs are fitted in normal operation.

2.2.5.1 EQUIPMENT FOR OIL-FILLING UNDER VACUUM

- (i) High-vacuum 2 storage oil filtration plant provided with thermostat-controlled oil heaters and vacuum-proof hoses with dependent vacuum pumping system for tank evacuation. Capacity :6 kl/hr
- (ii) Oil-storage tanks provided with silica-gel breathers and inlet / outlet valves for oil circulation. Recommended capacity 20kl
- (iii) Vacuum gauges provided in filtration plant.
- (iv) Equipment for measurement of electric strength (BDV) of oil - 100 kv set.
- (v) Equipment for moisture content of oil.
- (vi) Equipment for measurement of Resistivity and Tan delta at 90 C.
- (vii) Transparent vacuum-proof tubes for checking of oil-level during oil filling.
- (ix) Valves, fitting, gaskets etc.
- (x) Dry nitrogen cylinders.

2.2.5.2 COMMISSIONING

Testing after Assembly of the Transformer

After the transformer/has been assembled at site, it shall be tested in order to check that it has not been damaged during transport and assembly to such an

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extent that its future operation will be at risk. Regarding the performance of the test, refer to the testing method as per standards. The results of the test shall be documented.

COMMISSIONING CHECKS

SL NO DESCRIPTION

1. Breather Silica gel (Blue when dry)
2. Oil in the Breather housing cup.
3. All valves for their correct opening and closing sequence.
4. Oil level in conservator tank.
5. Oil in cooling system.
6. Oil level in bushings.
7. Release air, wherever necessary.
8. Cooling accessories (Pump motors, Fan motors etc.) for direction and O/L setting.
9. Buchholz, oil level indicator, pressure gauges, thermometer, Temp. indicators etc.
10. Neutral earthing.
11. Earth Resistance of Electrodes.
12. Earthing of bushing test tap.
13. Check oil leakage for 24 hrs.
14. Check Auxiliary circuit voltage (415 V)
15. Calibration of OTI / WTI with hot oil.
16. Check Working of WTI / RTD repeaters at control room.
17. IR of core to earth.
18. Die electric strength of oil PPM & Chemical analysis, specific gravity test
19. IR tests on windings to earth and between winding
20. Phase sequence test & vector group check
21. Continuity test
22. No load voltage ratio on all tap position
23. Winding resistance in all taps
24. Tap changing at 415v 3 50 Hz supply in all three phases
25. TAN-DELTA test if quality check list calls for.
26. Dew point check for N2 Gas at the time of oil filling

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INSULATION RESISTANCE TEST

Sl.No	Description	Date	Time in Hrs	Megger	IR Value	Temp	Remarks
1	Control wiring			500 V			
2.	Tap Changer						
	a) Motor						
	b) Control						
3.	Cooling system						
	a) Motor Fan						
	b) Motor pump						
	c) Control Wiring						
4.	Main Winding						
	a) HV/E+LV						
	b) LV/E+HV						
	c) HV/IV						
	d) IV/LV						
	e) HV/LV						

Note :-

- (1) While checking these values no external, lightning arrestors etc should be in circuit.
- (2) Special care should always be taken while meggering the transformer winding to ensure that there is no leakage in the leads.
- (3) Megger voltage to be decided based on the voltage rating of equipment under test.

Oil Characteristics.

Take necessary precaution (regarding rinsing the bottle, cleaning hand, air bubble etc) while withdrawing the samples, Each sample should be free of air bubbles and should not be tested when it is hot. The sample should satisfy IS:1866.

1. Tank Top Sample Bottom Sample
2. Cooling system Top Sample Bottom Sample
3. OLTC Divertor (each phase)

Tests on CT

1. Ratio
2. Polarity
3. Magnetising current
4. IR Value

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Potential Transformer Tests

1. IR test of primary winding by HV megger between windings
2. IR test of secondary winding by LV megger between winding and winding to earth
3. Checking of voltage ratio
4. Verification of terminal markings and polarity
5. Checking of oil level if applicable
6. Checking of continuity and IR values for cables from PT to M
7. Checking tightness of earthing connection.
8. Checking of insulator for cracks
9. Checking output on charging of the system with connected meter

On Load Tap changer

Sl.No	Description	Date	Observation	Remarks
1.	Visual Inspection of equipment.			
2.	Hand operation on II taps.			
3.	Complete wiring of the circuits.			
4.	Limit Switch			
5.	Over running device			
6.	Remote Panel Wiring.			
7.	Overload Device of Driving Motor.			
8.	Local Operation (Electrical)			
9.	Remote Operation (Electrical)			
10.	Tap Position Indicator.			
11.	Step by step contractor			
12.	Out of Step Relay.			

Note

- 1) While operating the mechanism on Electrical Control, check once again limit switches, step by step contractor, over running device etc. for their actual operation and prove that they are functioning properly.
- 2) For More details Please refer Respective Manuals.

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2.2.5 GUIDELINES FOR ERECTION OF HT SWITCHGEAR PANELS

2.2.5.1 Erection

The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated and painted at site. Base frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed.

2.2.5.2 All the panels/board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.

2.2.5.3 All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / interpanel wiring, etc. will have to be done after assembling the panel.

2.2.5.4 THE FOLLOWING POINTS SHALL BE CHECKED UP DURING ERECTION

1. Layout of foundation channels.
2. Floor level covered by the panel with respect to main floor level.
3. Location and serial no. of panels.
4. Positioning of panels.
5. Verticality of switchgear panels within the limit specified.
6. Freeness of Breaker Truck and modules in housing and its manual operation.
7. Earthing of panels and breaker truck to station earth.
8. Lugs for termination of HT and LT cables.
9. Mounting and fixing arrangements of Bus bars.
10. Tightening of Busbar jointing bolts as specified.
11. Clearance between :
 - i. Phase to Phase
 - ii. Phase to earth
12. Minimum clearance for:
 - i. Breaker, Truck and moduls withdrawal
 - ii. Distance required for maintenance work
13. Check the operation of:
 - i. Remote control
 - ii. Various required - closing / tripping / alarm / indications / interlocks

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14. Installation position of insts and relays
Operation of relays and meters by secondary injection.
15. AC/DC supplies for panel
Final relay settings as per customer requirements.
16. Tightness of terminal connections for HT & LT connections.
17. Opening operation of breaker, manually and electrically.
18. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

2.2.5.5 HT SWITCHGEAR TESTS

1. IR test
2. HV one minute P.F. test checking of oil level
3. Measurement of contact resistance for HT breakers
4. Test to prove inter changeability of similar parts (including breaker module)
5. Testing of relays as per supplier's commissioning manual
6. Testing and calibration of all meters.
7. Operation of all relays by secondary injection method
8. Testing of CT polarities and CT ratio by primary injection test.
9. Measurement of knee point voltage and secondary resistance for CTs used for differential protection.'
10. IR and voltage ratio test for PTs
11. Functional test of all circuit components for each panel / feeder.
12. Test to prove closing/tripping operation at minimum and maximum specified voltage in test and service position.
13. Check for drawout test and service position of breakers for all feeders.
14. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.
15. HV test on vacuum interrupters (for VCBs)
16. Check for pressure of SF6 gas and air (for SF6).

2.2.6 LT SWITCHGEAR PANELS

1. Erection
 - 1.1 The base frames will be supplied normally along with the boards. These will have to be aligned, levelled and grouted in position as per approved drawings. Wherever the base channels are not available, the same will have to be fabricated

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and painted at site. Base frames shall be grouted on the openings which shall be made on the floor during the time of casting. All necessary concrete chipping and finishing works are to be completed.

1.2 All the panels/board shall be placed on its foundation or supporting structures and shall be assembled as required. All panels should be installed with parallel, horizontal and vertical alignment by skilled craftsmen

1.3 All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel / inter panel wiring, etc. will have to be done after assembling the panel.

2. Checks during erection

1. Layout of foundation channels.
2. Floor level covered by the panel with respect to main floor level.
3. Location and serial no. of panels.
4. Positioning of panels.
5. Verticality of switchgear panels within the limit specified.
6. Freeness of Breaker Truck and modules in housing and its manual operation.
7. Earthing of panels and breaker truck to station earth.
8. Lugs for termination of LT cables.
9. Mounting and fixing arrangements of Bus bars.
10. Tightening of Busbar jointing bolts as specified.
11. Clearance between :
 - i. Phase to Phase
 - ii. Phase to earth
12. Minimum clearance for :
 - i. Breaker, Truck and moduls withdrawal
 - ii. Distance required for maintenance work
13. Check the operation of:
 - i. Remote control
 - ii. Various required - closing / tripping / alarm / indications / interlocks
14. Installation position of instruments and relays
Operation of relays and meters by secondary injection.
15. AC/DC supplies for panel
Final relay settings as per customer requirements.
16. Tightness of terminal connections for HT & LT connections.
17. Opening operation of breaker, manually and electrically.

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18. Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

3 LT Switchgear tests

1. IR test
2. Measurement of contact resistance for LT breakers
3. Test to prove inter changeability of similar parts (including breaker module
4. Testing of relays as per supplier's commissioning manual.
5. Testing and calibration of all meters.
6. Operation of all relays by secondary injection method.
7. Testing of CT polarities and CT ratio by primary injection test.
8. Measurement of kneepoint voltage and secondary resistance for CTs used for differential protection
9. IR and voltage ratio test for PTs
10. Functional test of all circuit components for each panel / feeder
11. Test to prove closing / tripping operation at minimum and maximum specified voltage in test and service position
12. Check for drawout test and service position of breakers for all feeders
13. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.

2.2.7 BATTERY AND BATTERY CHARGER

1 Battery Checks

1. Checking for completion of civil/ventilation requirement of battery room.
2. Checking of adequacy of charger output/requirement w.r.t. current required battery charging as per the manual
3. Check availability of safety devices, water and first aid
4. Check polarity of connections between battery and charger
5. Visual inspection test for level and leakages
6. Checking of layout as per approved drawing
7. Checking of IR value from positive to earth and negative to earth
8. Checking of voltage per cell and total voltage between positive negative and earth to positive/negative and also tap cell voltage (as applicable)
9. Checking of tightness of connectors on each cell

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10. Checking of capacity test and hourly measurement of specific gravity and voltage for each cell

2 Battery Charger

1. IR test.
2. HV test.
3. Checking voltage ratio of boost and float mode transformers.
4. Checking for charging mode of batteries, constant current and constant voltage mode.
5. Load test on chargers by running of DC drives and by liquid resistance system.
6. Checking of tightness of earthing connections.
7. Check for all alarm conditions.
8. Checking and calibration of all indicating meters.
9. Check functional operation of charger, auto/manual change over from float to boost and boost to float etc.
10. Checking and setting of all relays.
11. Check AC ripple in boost and float mode after charging.
12. Check polarity of cables connected to battery.

3. Additional tests

- a. Insulation resistance and earth resistance checks.
- b. Primary and secondary injection test.
- c. Calibration of all instruments
- d. Tests at normal voltage and when required at reduced voltage to prove satisfactory closing and tripping from local and remote points, checking of tripping from relay and protective gear, inter-tripping, interlocks etc. Reduced voltage test at 70% rated voltage to prove tripping of each circuit breaker.
- e. Battery capacity test

2.2.8 GUIDELINES FOR CABLE LAYING

- 1) In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.

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- 2) In case of multi-core cables of diameter upto 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.
- 3) Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.
- 4) GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends
- 5) In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be provided.
- 6) Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.
- 7) Cables laid exposed in racks/trays and routed through trenches/tunnels/basements etc. to individual drive/control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.
- 8) All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers upto a height of 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.
- 9) Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust/atmospheric abuses etc.
- 10) Cable trays shall be supported on ISA 50x50x6mm MS/GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.
- 11) Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.
- 12) For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.
- 13) If required, a few numbers of cables in exceptional areas may be directly buried into the earth.
- 14) Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.
- 15) At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.
- 16) In corrosive atmosphere, PVC conduits shall be used for cables.

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- 17) Single core cables, when pulled individually shall be taken through PVC pipes only.
- 18) Laying and installation of power, control and special cables shall generally conform to IS : 1255
- 19) The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 20) In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.
- 21) Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.
- 22) Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.
- 23) All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor/wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cable.
- 24) When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.
- 25) Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.
- 26) Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacing not less than one cable diameter of bigger diameter cable.
- 27) All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles / aluminium strips / nylon cable ties. Cables above 35mm diameter shall be clamped individually.
- 28) Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp/tie.
- 29) Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:
 - 29.1 HT cables shall be laid in the top tier(s)

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- 29.2 LT power cables to be laid in the tray(s) below the HT cable trays.
 - 29.3 LT control cables to be laid in the Tray(s) next below to the LT power cable (trays)
 - 29.4 Special control cables including screened control cables to be laid in the bottom most tray(s).
- 30) For vertical formations, the trays closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed. However, where there is no clear distinction of bottom / top trays, the order convenient for linking the horizontal and vertical formations shall be followed.
- 31) When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses 29 & 30 indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required. In hierarchical order:
- 31.1 Control cables are mixed up with the special control cables with clear minimum gap of 100 mm between them.
 - 31.2 LT power cables are mixed up with control cable with clear minimum gap of 150 mm between them.
 - 31.3 LT power cables are mixed up with HT power cables with clear minimum gap of 200 mm between them.
 - 31.4 LT power cables are mixed up with special control cables with clear minimum gap of 200 mm between them.
- 32) In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench / tunnel / basement.
- 33) For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanised.
- 34) For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6 mm thickness.
- 35) To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.
- 36) No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits/pipes in trefoil formation only.

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- 37) In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.
- 38) Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.
- 39) Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.
- 40) **SUPPORT SPACINGS & CLAMPINGS**
Support spacing and clamping suitably provided and as required
- 41) **LAYING OF CABLES DIRECTLY BURIED IN GROUND**
Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.

42) **SUPPORT SPACINGS & CLAMPINGS**

Trefoil Clamps:	
i. Horizontal run spacing	1000 mm (max)
ii. Vertical run spacing	1000 mm (max)
iii Axial spacing between adjacent trefoils	Double the diameter of larger cable or 150 mm Whichever is less

Other Clamps

A. Power Cables:

Above 35mm OD

- i) Horizontal runs : Individually clamped at 3000 mm Interval (max)
- ii) Vertical runs : Individually clamped 3000mm intervals (max).

Upto 35mm OD

- i) Horizontal runs : Collectively clamped at 3000 mm intervals (max)
- ii) Vertical runs : Collectively clamped at 2000 mm interval (max)

B. Control Cables:

- i) Horizontal runs : Collectively clamped at 3000 mm interval (max)
- ii) Vertical runs : Collectively clamped at 3000 mm interval (max)

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C. Spacing for cables supported along structure/ceiling

Clamping Spacing:

- i) In horizontal runs : 750mm (max)
- ii) In vertical runs : 750mm (max)

Spacing between cables : 30 mm (min)

Note:

- a. Supports shall also be provided at each bend.
- b. For any change in above spacing, prior approval of Engineer will be taken

43) CABLE TERMINATION AND JOINTING

- a. When the equipment are provided with undrilled gland plates for cable/conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.
- b. Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores/wires at terminals as shown in interconnection diagrams is to be done.
- c. All cable entries in the equipment shall be sealed after glanding the cables.
- d. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor.
- e. Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.
- f. End sealing/termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.
- g. Termination and jointing of aluminium/copper conductor power cables shall be done by means of compression method using compression type aluminium/tinned copper lugs.
- h. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.
- i. Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable, the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.

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- j. Termination and jointing shall generally conform to the requirements of IS: 1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.

44) TESTING OF CABLES:

- i. The contractor shall submit to the Engineer a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist.
- ii. Testing and electrical measurement of cable installations shall conform to IS : 1255
- iii. Prior to installation, cables shall be tested for :
 - a) Continuity of conductors
 - b) Insulation resistance between conductors & earth
 - c) Insulation resistance between conductors.
- iv. After installation cables shall be tested for :
 - a) Insulation resistance between conductors & iron
 - b) Insulation resistance between conductors & earth
 - c) Conductor resistance
 - e) Capacitance between conductors & earth (for cables above 7C.1.3KV grade)
 - f) DC high voltage test (for LT power cables of higher sizes interconnecting PCCs & MCC)
 - g) Absence of cross phasing
 - h) Firmness of terminations.

2.2.9 TESTS FOR THE EQUIPMENT ERECTED BY MECHANICAL CONTRACTOR

The tests to be carried out on the equipment at which are normally being erected by Mechanical contractor.

a) Generator :

Generator set with all auxiliaries and controls shall be assembled and tested to verify compliance with the guaranteed technical particulars and for satisfactory performance. Relevant standards shall be followed as guideline for testing. All the tests shall be witnessed by customer or its representative. The commissioning tests shall be carried out at site under normal service conditions.

Following tests shall be carried out on the generators:

1. Insulation resistance test and determination of polarization index value of:
 - Generator
 - Exciter
 - Resistance temperature detectors
2. Dielectric test

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3. No load characteristics
4. Short circuit characteristics
5. Temperature rise at rated voltage, current, power factor and frequency.
6. Over-speed test
7. Calculation of efficiency
8. Phase sequence / voltage balance / current balance checks.

Note :

- a) Vibration tests in the factory to be taken at 100% of synchronous speed and at 120% during over-speed test.
 - b) Vibration test at site to be taken at 100% of synchronous speed of the complete generator with its driver.
9. Instantaneous short circuit test (Optional).
 10. Noise measurement test.
 11. Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.
 12. Temperature detector test
 13. Measurement of DC resistance of winding
 14. Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minutes (if applicable).
 15. Measurement of shaft voltage.
 16. Tan Delta test for generator bushing (If required).

b) AC Motors

1. IR test of stator and rotor windings.
2. Heating of both windings upto the permissible temp.
3. Checking/testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed.
4. Tightness of cable connection.
5. Winding resistance measurement of stator and rotor.
6. Checking continuity of winding.
7. Checking tightness of earth connections.
8. Checking space heaters and carryout heating of winding (if required)
9. Checking direction of rotation in decoupled condition during kick start
10. Measurement of no load current for all phases
11. Measurement of temperature of body during no load and load conditions.

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12. Check for tripping of motor from local/remote switches and from.
13. Checking of vibration (if required).
14. Checking of noise level (if required)
15. Measurement of stator and bearing temperatures during load running (if applicable) for every half an hour interval till saturation comes.
16. Checking operation of speed switch (if there)
17. Checking of polarisation index of stator winding, R10/R1 by motorised megger (The value should not be less than 2.0) R60/10 absorption coefficient shall not be less than 1.5.
18. Dielectric test.

c) DC Motors

1. IR measurement and heating the winding as per heating curve.
2. Check for earth connection
3. Winding resistance for field and armature.
4. Check running of drive at minimum and maximum specified.
5. Check auto start of drive on failure of AC supply (if applicable)
6. Check operation of overload relay.
7. Measure vibration.
8. Check temperature rise on body of drive after required period of continuous running.
9. Measure load currents and no load currents (if possible)
10. Check direction of rotation.
11. Check continuity of winding.
12. Measurement of RPM.

2.2.10 CODES AND STANDARDS

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

2.2.10.2 Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

IS The electrical installation shall meet the requirement of Indian Electricity Rules as amended upto dates, relevant IS codes of Practice

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and Indian Electricity Act. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding. A list of applicable standards is given below for reference.

- IS 3043 Code of practice for earthing
- IS 3072 Installation and maintenance of switchgear
- IS 5133 Box for enclosure of electrical equipment
- IS 5216 Guide for safety procedure and practice in electrical work
- IS 13947 Degree of protection provided by enclosures for low voltage switchgear and control gear.
- IS 5216 Guide for safety procedures and practices in electrical works.
- IS 800 Code of practice for use of structural steel.

In addition to the standards mentioned above, all works shall conform to the requirements of the following rules and regulations.

- a) Indian Electricity Act and Rules framed thereunder
- b) Fire insurance regulations
- c) Regulations laid down by the Chief Electrical Inspector of State and CEA
- d) Regulations laid down by the Factory Inspector of State
- e) Any other regulations laid down by the authorities.

In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.

2.2.11 TECHNICAL REQUIREMENT FOR ITEMS SUPPLIED BY THE CONTRACTOR.

2.2.11.1 GENERAL

Equipment and material supplied shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

Equipment and materials furnished shall be complete and operative in add details.

All the accessories, fittings, supports, anchor bolts etc., which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

Samples of all items shall be made available for purchaser's approval prior to supply of item to site.

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2.2.11.2 FERRULES

- a) Ferrules shall be required for individual core of cable hence they shall be suitable for the insulated conductor diameter.
- b) Ferrules shall be of plastic material.
- c) Numbering on the ferrules shall be engraved type with contrast colour to the base. Engrave colouring shall be of durable quality to match the entire life of the plant. Engraving shall be legible from a distance of 600 mm.
- d) Ferrules shall be interlocking type in such a way that the interlocked ferrules take the shape of tube with complete ferrule number appearing in a straight line.

2.2.11.3 TAGS

- a) Cables shall be provided with cable number tags for identification.
- b) Cable tags shall be of durable fibre, aluminium or stainless steel sheets.
- c) Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fibre sheet.
- d) Tags shall be durable quality of size 60mm x 12mm with holes at both ends.
- e) Samples of tags shall be approved by BHEL Engineer before delivery.
- f) Tags shall be provided with non-corrosive wire of sufficient strength for taggings.

2.2.11.4 FIRE STOP CABLE SEALING SYSTEM (AS APPLICABLE)

Fire stop cable sealing system shall have two (2) hours fire protection rating suitable for sealing both vertical & horizontal cable penetrations. The sealing compound in conjunction with mineral wool shall form effective fire seals. The sealing compound shall have special property to allow for short circuit conditions. GPG fire stop sealing compo or equivalent sealing compound shall be used.

2.2.12 GUIDELINES FOR ERECTION OF GI PIPES , SUPPORTS & ACCESSORIES

- 2.2.12.1 For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.
- 2.2.12.2 For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.
- 2.2.12.3 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.

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- 2.2.12.4 The entire GI conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the GI pipes entering them.
- 2.2.12.5 Bends of GI pipes/conduits shall be made without causing damage to the pipes/conduits.
- 2.2.12.6 Occupancy of conduits shall not be greater than 40%.
- 2.2.12.7 The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanised steel.
- 2.2.12.8 Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255.
- 2.2.12.9 All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.
- 2.2.12.10 The cable drums shall be transported on wheels to the place of work.

Note : The test specified above for all the electrical equipment are not exhaustive. Any other pre-commissioning and field tests not included in the above list but necessary as per relevant standards, Electricity rules, code of practice and instructed by the manufacturer of the equipment shall also have to be carried if deemed necessary shall be carried out as per requirement either at free of cost or at additional cost. Decision of Engineer in charge will be the final regarding additional cost for testing. The contractor shall take the full responsibility of testing, commissioning, trial run and successful operation of the equipment under overall guidance of BHEL engineer

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VOLUME-IA PART- II CHAPTER -3 DATA SHEET

- 2.3.1 SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS
 - 2.3.1.1 Ferrules/ Fire stop cable sealing system / tags: As per Clause 2.2.11
 - 2.3.1.2 Tag
 - a. Material: Aluminium / Fiber / Stainless Steel
 - b. Markings: Engraving / Embossing / Printing
 - c. Size : As required.
 - 2.3.1.3 Cable lugs of size 2.5 Sqmm and below : Copper / Aluminium (crimping type)
 - 2.3.1.4 Anchor fasteners for wall mounted cable trays / JB's
 - 2.3.1.5 Insulation tape.
 - 2.3.1.6 Paints required for primer & final coating and for protective coating.
 - 2.3.1.7 Solder wire (Lead) -(60/40)
 - 2.3.1.8 Panel sealing compound material (for cable entry from bottom / top of Panel).
 - 2.3.1.9 Materials required for cable dressing. (GI / aluminum flats, PVC ties etc).
 - 2.3.1.10 PVC wire marker sleeves and Tag plates
 - 2.3.1.11 Welding electrodes, filler wires, gases etc.
- 2.3.2 Wastage Allowance:
 - Support installation : 1% by weight

VOLUME-IA PART – II CHAPTER 4
Drawing -layout of S.P. busduct

Available in next page

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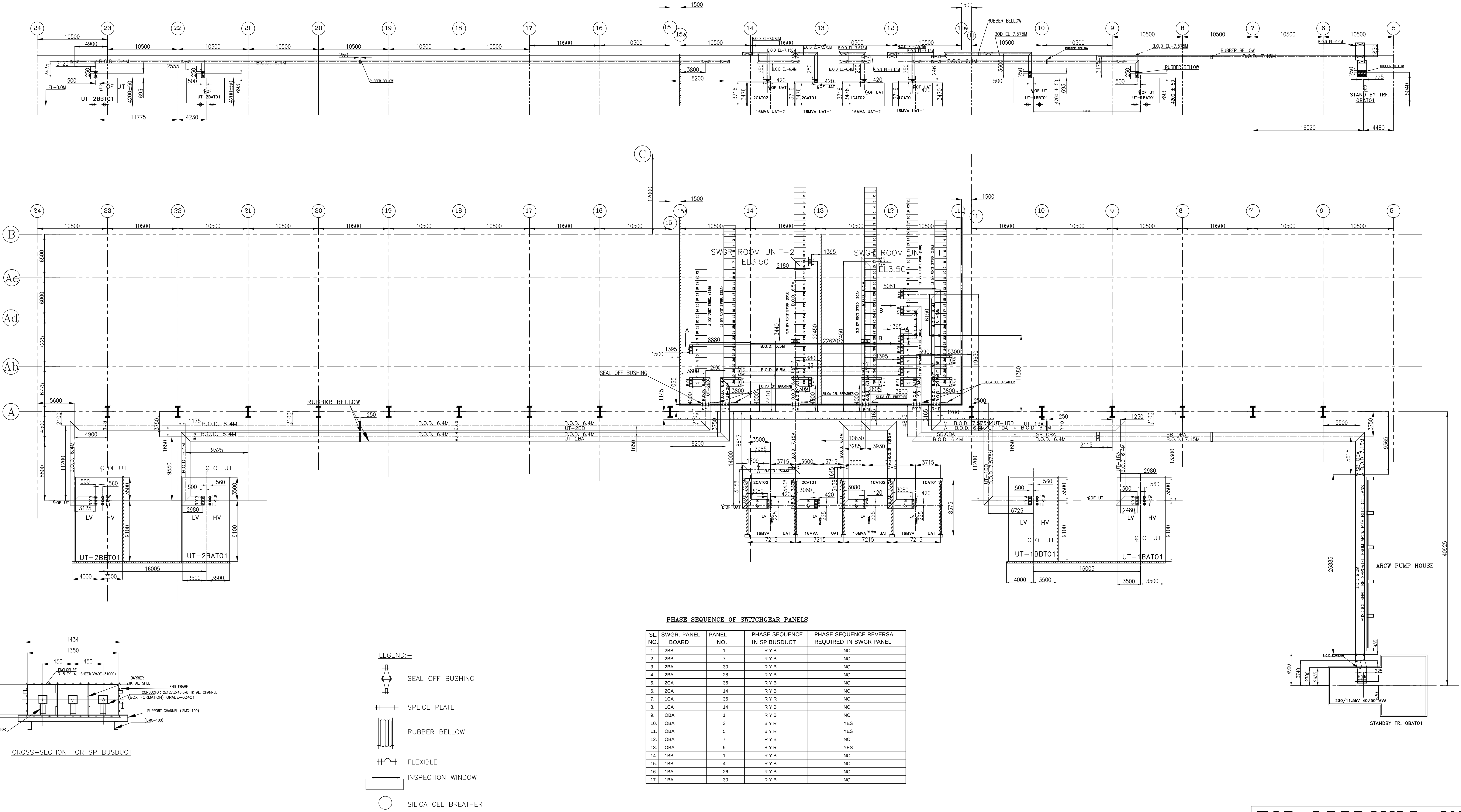
3

2

02/9601606/20
CUSTOMER'S DRAWING NO.

FIRST ANGLE PROJECTION

FOLD-2

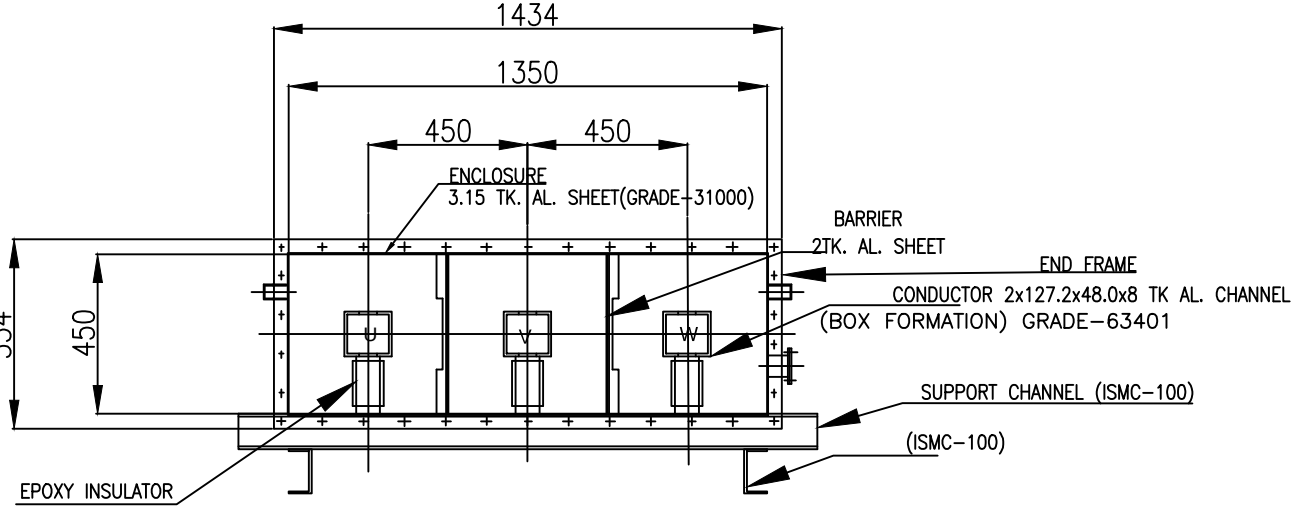


PHASE SEQUENCE OF SWITCHGEAR PANELS

SL. NO.	SWGR. PANEL BOARD	PANEL NO.	PHASE SEQUENCE IN SP BUSDUCT	PHASE SEQUENCE REVERSAL REQUIRED IN SWGR PANEL
1.	2BB	1	R Y B	NO
2.	2BB	7	R Y B	NO
3.	2BA	30	R Y B	NO
4.	2BA	28	R Y B	NO
5.	2CA	36	R Y B	NO
6.	2CA	14	R Y B	NO
7.	1CA	36	R Y R	NO
8.	1CA	14	R Y B	NO
9.	0BA	1	R Y B	NO
10.	0BA	3	B Y R	YES
11.	0BA	5	B Y R	YES
12.	0BA	7	R Y B	NO
13.	0BA	9	B Y R	YES
14.	1BB	1	R Y B	NO
15.	1BB	4	R Y B	NO
16.	1BA	28	R Y B	NO
17.	1BA	30	R Y B	NO

LEGEND:-

- SEAL OFF BUSHING
- SPLICE PLATE
- RUBBER BELLOW
- FLEXIBLE
- INSPECTION WINDOW
- SILICA GEL BREATHER



CROSS-SECTION FOR SP BUSDUCT

ENGG REF DWGS:-

TITLE:-

DRG NO.

SOURCE

- LAYOUT OF MV SWITCHGEAR ROOM AT EL 3.5 M
- OUTLINE GENERAL ARRANGEMENT OF UT
- OGA OF TRF. OBAT01
- TRANSFORMER YARD LAYOUT

PE-DG-307-100-E002 Rev. 02
04560050314 Rev. 00
34560051380 Rev. 00
PE-DG-307-100-E001 Rev. 02

PEM/ELEC.
BHEL/ JHANSI
BHEL/ JHANSI
PEM/ELEC.

NOTE.-

- TERMINAL BOXES CANNOT BE SHOWN IN THE LAYOUT. THE HEATER TERMINAL BOXES SHALL BE PROVIDED IN EACH SECTION OF SP BUSDUCT AND THE WIRING SHALL BE DONE FROM HEATER TERMINAL BOX TO HEATER MARSHALLING BOX AT SITE.
- RAIN HOOD MATERIAL IS ALUMINIUM ALLOY AND SHALL BE AS PER Drg. No. 02311010001 Rev.00.

FOR APPROVAL ONLY

CUSTOMER:-		TAMILNADU ELECTRICITY BOARD DCPL, CHENNAI	
PROJECT:-		2 X 600 MW NORTH CHENNAI TPP (STAGE-II, UNIT # 1 & 2)	
		BHARAT HEAVY ELECTRICALS LTD RUDRAPUR	
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DEPT. CODE	NAME	SIGN	DATE
E	DRN		
	CHD		
	APPD		
TITLE LAY OUT OF S.P.BUSDUCT			
DEPT. CODE	SCALE	DRAWING NO.	
SIGN	1:200	02311010001	
DATE		SHEET 1 OF 2	REV. 04

REV. DATE	CHD	REV. DATE	CHD	REV. DATE	CHD	REV. DATE	CHD
04 25/08/10	APPD	03 21/07/10	APPD	02 15/07/10	APPD	01 03/07/10	APPD
DRAWING REVISED AS PER THE COMMENTS OF PEM-SHEL REV.03.		DRAWING REVISED AS PER THE COMMENTS OF PEM-SHEL REV.03.		DRAWING REVISED AS PER THE COMMENTS OF PEM-SHEL.		DRAWING REVISED AS PER THE COMMENTS OF PEM-SHEL.	