

TENDER SPECIFICATION

BHEL: PSSR: SCT: 1453

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work,
Pre assy., Erection, Testing and Commissioning of LT 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: 1453

for

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of LT 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

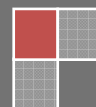
Place: Chennai -35

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 1453
ii	Broad Scope of job	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of LT Electrical Package as specified in the attached document 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> Applicable
b	Volume-IB	<i>Special Conditions of Contract (SCC)</i> Applicable
c	Volume-IC	<i>General Conditions of Contract (GCC)</i> Applicable
d	Volume-ID	<i>Forms and Procedures</i> Applicable
e	Volume-II	<i>Price Schedule (Absolute value).</i> Applicable

iv	Issue of Tender Documents	1. <u>Sale from BHEL PSSR Regional office at :Chennai</u> Start : Mar 18, 2011 Closes: Apr 07, 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 08, 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 08, 2011, Time :15.30Hrs 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: Mar 31, 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 appli cable
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	
	<u>ENVELOPE – II superscribed as:</u> 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:

ii. 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 Auxiliaries) 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 be 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 LT 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.
TENDER NO	BHEL PSSR SCT 1453

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 Electrical works of HT or LT switchgears, HT or LT busducts (Non segregated or segregated or isolated), control panels, cabling (Power / Control), cable trays and other related works of minimum one unit rating of 190 MW or above in any Power Plant (Utility / CPP- coal based or gas based) in the last seven years. The bidder should possess valid Electrical installation license. The term “Executed” means the unit should have been synchronized.		
D 1	<u>Financial</u> TURNOVER Bidders must have achieved an average annual financial turnover (audited) of Rs 165 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

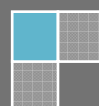
VOLUME – IA

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 1175.7mm.

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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

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

1.2.0 SCOPE OF WORK IN GENERAL:

1.2.1 Scope of Electrical works covered in this tender are as follows:

- 1.2.1.1 Erection and commissioning of Battery & battery charger panels.
- 1.2.1.2 Erection and commissioning of LT MCC, AC / DC Distribution Boards, Starter Panels, etc.
- 1.2.1.3 Erection and commissioning of LT Bus Ducts.
- 1.2.1.4 Erection and commissioning of Diesel Generator Set
- 1.2.1.5 Erection and commissioning of Control Panels
- 1.2.1.6 Erection of Trays & accessories and Trays supports.
- 1.2.1.7 Installation of local push button stations, local starter, Junction Boxes etc.
- 1.2.1.8 Laying and termination of LT cables including supply of ferrules, tag plates, and cable dressing materials as detailed in scope of cabling.
- 1.2.1.9 Installation of above ground earthing grid, earthing of equipment / cable racks / trays etc. as applicable.
- 1.2.1.10 Installation of Lightning protection
- 1.2.1.11 Fabrication and installation of steel supports wherever required.
- 1.2.1.12 Commissioning of LT-drives and electrically operated equipment erected by Mechanical contractor.
- 1.2.1.13 Installation of other items that have not been specifically indicated, but required for completing installation.
- 1.2.1.14 Supply of paints and painting of items covered in the scope of works.
- 1.2.1.15 Erection and commissioning of Electrical heat tracer system for pipe lines

1.2.2 GENERAL

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

- 1.2.2.1 Identification of equipment at storage yard, technical assistance for checking and making the shortage / damage reports, taking delivery at storage yard / stores and pre-assembly of equipment wherever required, erecting, checking, carrying out statutory tests as required, pre-commissioning, commissioning & post-commissioning activities up to trial operation of the unit and handing over to

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customer or till completion of contract period whichever is earlier, along with the supply of all consumables, tools and tackles, testing instruments. The installation and commissioning of all the electrical equipments / items shall conform to the technical requirements specified elsewhere in the tender.

- 1.2.2.2 It is not the intent to specify herein all details of material. Any item related to this work not covered, but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.2.2.3 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.
- 1.2.2.4 Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.
- 1.2.2.5 Supply of paints and consumables as per clause 1.3.6
- 1.2.2.6 Final painting including supply of paints.

Note:

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

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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	
	PART I			
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	
	PART II			
	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		
1.3.2.1.2	Drawings for construction methods		Yes	In consultation with BHEL

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Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART II			
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, cable schedule & wiring diagrams	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 at the nearest substation. 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's decision is final
- 1.3.4.2 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.
- 1.3.4.3 If contractor needs a second connection for working at locations far away from the first connection, BHEL at its discretion, may give the connection depending on the availability of spare capacity and feeders. Contractor shall make arrangements for installing energy meter at his own cost for the second connection. The contractor shall make his own arrangement for further distribution with necessary isolator / LCB etc.
- 1.3.4.4 As per clause no 1.5.1, EOT crane without operating personnel shall be made available to the bidder, free of charge, however the electric power consumption for the EOT Crane will be charged as mentioned above.
- 1.3.4.5 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.
- 1.3.4.6 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.
- 1.3.4.7 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.

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1.3.4.8 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 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. PVC wire marker sleeves and Tag plates
- ix. Lugs of size 2.5 Sqmm and below.
- x. GI / aluminum flats / clamp for cable dressing
- xi. PVC cable ties
- xii. Anchor fasteners for wall mounted cable trays / JB's

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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 and MMEs shall be deployed by the contractor for execution of this contract with in the quoted rate:

- 1.4.1 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. 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.
- 1.4.2 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-Only if rate schedule includes oil filled transformers
 - 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. Variac - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.
 - x. Primary injection kit - 0-5000 A.
 - xi. Secondary injection kit - 0-5A.
 - xii. Wheatstone bridge - 0.05 m ohm - 100 ohm.
 - xiii. Oscilloscope
 - xiv. Air compressor -if required
 - xv. Oil Tank for transformer oil filtration- Only if transformers are included in rate schedule
 - xvi. Vacuum pump.-If required

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- xvii. Phase sequence meter - 110V - 450V - 25 to 65Hz.
- xviii. Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.
- xix. Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.
- xx. Tachometer etc.
- xxi. mA Source
- xxii. Standard pressure gauges-If required
- xxiii. Temperature oil bath-If required
- xxiv. Tan Delta Test kit-Only if HV transformers are included in rate schedule
- xxv. Oil specific gravity and PPM measuring equipment- Only if HV transformers are included in rate schedule
- xxvi. Dew point measurement instrument-If required
- xxvii. Three phase relay testing kit like omicron-To be brought when required
- xxviii. Contact resistance measurement kit
- xxix. Micro ohm meter

1.4.3 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 digit
		Philips Voltage 200mV to 1000 V AC	$\pm 1\%$ + 1 digit
		Hcl Current 200mA to 20 A AC	$\pm 0.8\%$ + 1 digit
		Philips Current 20 mA to 20 A AC	$\pm 0.8\%$ + 1 digit
		Resistance (Hcl) 2120 200* to 200M*	$\pm 0.5\%$ + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	$\pm 0.25\%$ + 1 digit
		Hcl Voltage 200mA to 750 V	$\pm 0.8\%$ + 1 digit
		Philips Current 20 mA to 20 A DC	$\pm 0.5\%$ + 1 digit
		Hcl Current 200 mA to 010 A AC	$\pm 1\%$ + 1 digit

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4	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	$\pm 0.5\%$ mm/sec
		Displacement upto 300 microns	± 2 microns
5	Secondary Injection Kit	Upto 5A	$\pm 0.5\text{mA}$
6	Motor operated Megger	Upto 200 Ohms	$\pm 5\%$ at Centre scale
7	Tongue tester	0/300/600A AC	$\pm 5\%$
		0 to 300A DC	$\pm 5\%$
8	Tachometer (Hand held)	0 to 4000 rpm	$\pm 5\%$
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	0-10mm	± 0.01 mm
13	Hand operated Megger 500 V / 1000V	Upto 200 M Ohms	$\pm 5\%$ at Centre Scale
			$\pm 10\%$ at end of Scale
14	Motorised Megger 2.5 KV	Upto 200 M Ohms	$\pm 5\%$ at Centre Scale
			$\pm 10\%$ at end of Scale
15	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	$\pm 5\%$ at Centre Scale range
16	AC tongue Tester	0 to 300A AC	$\pm 3\%$
17	DC Tongue Tester	0 to 300A DC	$\pm 5\%$
18	High Voltage test Kit	Upto 50 KV AC	$\pm 10\%$
		Upto 70 KV DC	$\pm 10\%$
19	Tacho Generator (Mech)	0 to 4000 rpm	$\pm 0.25\%$
20	DC Ammeter	0 to 300 A	$\pm 10\%$
21	DC Voltmeter	0 to 500 V	$\pm 10\%$
22	Motor direction checker		

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1.4.4 OTHER REQUIREMENTS OF CONTRACTOR'S INSTRUMENTS & T&P

- a. The contractor shall arrange all the above T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.
- b. Any other tools and plants instruments and equipment required in addition to the above other than propriety type T&P / Instruments for the successful completion of this job shall 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 shall be sent for testing and calibration wherever from time to time and maintained by contractor as required by BHEL.
- f. List of such agencies and periodicity of calibration required for different instruments shall be furnished by BHEL at site.
- 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.

- 1.5.1 Subject to availability, BHEL will provide EOT cranes for the purpose of shifting the panels within the Power House building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. The Electricity charges for EOT crane shall be as per clause no 1.3.4

Note:

- a) Providing manpower assistance required for free movement of trailing cable of EOT Crane is included in the scope of this contract.
- b) Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

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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 carry out 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 Clause 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 Clause no 1.7.1.1.1 to 1.7.1.8.1 of the following table.

TERMS OF PAYMENT FOR LT 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	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	Miscellaneous 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 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	Testing / Commissioning of Equipment (like motors, actuators, misc equipments, etc) erected by other agencies	
1.7.1.8.1	Local testing	40%
1.7.1.8.2	Remote testing, Loop testing, and commissioning	40%
1.7.1.8.3	System commissioning	5%
	Total =	85%
1.7.1.9	Other items	
1.7.1.9.1	Rubber mats / Display Boards / Miscellaneous items / etc : on installation	85%
1.7.1.9.2	Specialised Commissioning Services - on pro rata basis.	85%
1.7.1.9.3	Civil Works / Structural works - Prorata on completion of actual work.	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 for the erected items as mentioned in Clause no 1.7.2 of the following table.

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 QUANTITY (BOQ)

BILL OF QUANTITY FOR ERECTION, TESTING AND COMMISSIONING OF LT ELECTRICAL PACKAGE (Bill of Quantity (BOQ) contains detailed specification of various instruments and items, BHEL Unit-wise and system-wise.			
BOQ. Ref.no	Description	Qty–unit 1	Qty–unit 2
A.	BHEL- PEM SCOPE		
A.1.0	LT BUS DUCTS (<i>clause 1.7.1.7</i>)		
A.1.1	Non segregated LT 415 V, 4000/3000/2500A Bus ducts of rectangular shape with rubber bellows, adapter box, wall frame, copper flexible, hardwares and support structures etc. for connection of LT transformers to PCC / MCC including fabrication of supports & erection.	275 Mtrs	135 Mtrs
	Rating of Bus duct		
	4000A - 06 Nos. for unit1 & 04 Nos. for unit2		
	3000A - 06 Nos. for unit1 only.		
	2500A - 14 Nos. for unit1 & 08 Nos. for unit2		
	Approximate Weight of the bus duct - 80 kg/Mtr		
	Approximate Weight of Support structural material - 5000 Kg for both units.		
A.2.0	LOW VOLTAGE SWITCHGEAR/ CONTROL PANELS (<i>clause 1.7.1.5</i>)		
A.2.1	Station Service PMCC # 0DA, 4000 A	1 No.	-
	Approximate Dimension: 12000(L) x 1600(D) x 2425(H) mm, Approximate weight 14500 kg		
A.2.2	Station Service PMCC # 0DB, 4000 A	-	1 No.
	Approximate Dimension: 12000(L) x 1600(D) x 2425(H) mm, Approximate weight 14500 kg		
A.2.3	Unit Service PMCC #1DA, 4000 A	1 No.	-
	Approximate Dimension: 17400(L) x 1600(D) x 2425(H) mm, Approximate weight 23550 kg		
A.2.4	Unit Service PMCC #2DA, 4000 A	-	1 No.
	Approximate Dimension: 17400(L) x 1600(D) x 2425(H) mm, Approximate weight 23550 kg		

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A.2.5	Fuel Oil Pump house PMCC #0DC, 2500 A	1 No.	-
	Approximate Dimension: 11600(L) x 1600(D) x 2425(H) mm		
	Approximate weight 11350 kg		
A.2.6	Fire Water P/H PMCC #0DD, 2500 A	1 No.	-
	Approximate Dimension: 10000(L) x 1600(D) x 2425(H) mm		
	Approximate weight : 9850 kg		
A.2.7	Water System PMCC #ODE, 3000 A	1 No.	-
	Approximate Dimension: 9600(L) x 1600(D) x 2425(H) mm		
	Approximate weight : 8850 kg		
A.2.8	AHP Vacuum P/H & Comp. House PMCC # ODF, 2500 A	1 No.	-
	Approximate Dimension: 21200(L) x 1600(D) x 2425(H) mm		
	Approximate weight : 23600 kg		
A.2.9	ASH Slurry cum Water P/H PMCC# 0DG, 4000 A	1 No.	-
	Approximate Dimension: 22000(L) x 1600(D) x 2425(H) mm		
	Approximate weight : 22900 kg		
A.2.10	Unit Emergency MCC # 1DG, 3000 A	1 No.	-
	Approximate Dimension: 18800(L) x 1600(D) x 2425(H) mm, Approximate weight : 17000 kg		
A.2.11	Unit Emergency MCC # 2DG, 3000 A	-	1 No.
	Approximate Dimension: 18800(L) x 1600(D) x 2425(H) mm, Approximate weight : 17000 kg		
A.2.12	220 V Main DCDB #1FA, 1000A	1 no.	-
	Approximate Dimension: 10600(L) x 900(D) x 2425(H) mm, Approximate weight 9400 kg		
A.2.13	220 V Main DCDB #2FA, 1000A	-	1 no.
	Approximate Dimension: 10600(L) x 900(D) x 2425(H) mm, Approximate weight 9400 kg		
A.2.14	Boiler MCC# 1HA, 1000A	1 No.	-
	Approximate Dimension: 8500(L) x 900(D) x 2425(H) mm, Approximate weight : 7350 kg		
A.2.15	Boiler MCC# 2HA, 1000A	-	1 No.
	Approximate Dimension: 8500(L) x 900(D) x 2425(H) mm, Approximate weight : 7350 kg		

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A.2.16	Boiler Valve & Damper ACDB # 1HB, 250 A	1 No.	-
	Approximate Dimension: 8800(L) x 900 (D)x 2425 (H)mm, Approximate weight 7150 Kg		
A.2.17	Boiler Valve & Damper ACDB # 2HB, 250 A	-	1 No.
	Approximate Dimension: 8800(L) x 900 (D)x 2425 (H)mm, Approximate weight 7150 Kg		
A.2.18	Boiler ACDB # 1HC, 630 A	1 No.	-
	Approximate Dimension: 7700(L) x 900 (D)x 2425 (H) mm, Approximate weight 6800 Kg		
A.2.19	Boiler ACDB # 2HC, 630 A	-	1 No.
	Approximate Dimension: 7700(L) x 900 (D)x 2425 (H) mm, Approximate weight 6800 Kg		
A.2.20	ESP & ID FAN Area MCC #1HD, 250 A	1 No.	-
	Approximate Dimension: 3200(L) x 900(D) x 2425(H) mm, Approximate weight : 2600 kg		
A.2.21	ESP & ID FAN Area MCC #2HD, 250 A	-	1 No.
	Approximate Dimension: 3200(L) x 900(D) x 2425(H) mm, Approximate weight : 2600 kg		
A.2.22	Bottom Ash Handling MCC # 1HE, 400 A	1 No.	-
	Approximate Dimension: 4000(L) x 900(D) x 2425(H) mm, Approximate weight : 3250 kg		
A.2.23	Bottom Ash Handling MCC # 2HE, 400 A	-	1 No.
	Approximate Dimension: 4000(L) x 900(D) x 2425(H) mm, Approximate weight : 3250 kg		
A.2.24	Turbine MCC # 1KA, 1000 A	1 No.	-
	Approximate Dimension: 10100(L) x 900 (D) x 2425 (H) mm, Approximate weight 8700 Kg		
A.2.25	Turbine MCC # 2KA, 1000 A	-	1 No.
	Approximate Dimension: 10100(L) x 900 (D) x 2425 (H) mm, Approximate weight 8700 Kg		
A.2.26	Turbine Valve ACDB #1KB, 250 A	1 No.	-
	Approximate Dimension: 14400(L)x 900 (D) x 2425 (H) mm, Approximate weight 11700 Kg		
A.2.27	Turbine Valve ACDB #2KB, 250 A	-	1 No.
	Approximate Dimension: 14400(L)x 900 (D) x 2425 (H) mm, Approximate weight 11700 Kg		
A.2.28	Unit Service ACDB #1QA, 630 A	1 No.	-
	Approximate Dimension: 5300(L)x 900 (D) x 2425 (H) mm, Approximate weight 4850 Kg		

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A.2.29	Unit Service ACDB #2QA, 630 A	-	1 No.
	Approximate Dimension: 5300(L)x 900 (D) x 2425 (H) mm, Approximate weight 4850 Kg		
A.2.30	Air Washer MCC #1SA, 630 A	1 No.	-
	Approximate Dimension: 6900(L) x 900(D) x 2425(H) mm, Approximate weight : 4950 kg		
A.2.31	Air Washer MCC #2SA, 630 A	-	1 No.
	Approximate Dimension: 6900(L) x 900(D) x 2425(H) mm, Approximate weight : 4950 kg		
A.2.32	Ventilation MCC #1TA , 1000 A	1 No.	-
	Approximate Dimension: 7700(L) x 900(D) x 2425(H) mm, Approximate weight : 6800 kg		
A.2.33	Ventilation MCC #2TA , 1000 A	-	1 No.
	Approximate Dimension: 7700(L) x 900(D) x 2425(H) mm, Approximate weight : 6800 kg		
A.2.34	ESP A/C & VENT. MCC #1TB, 400 A	1 No.	-
	Approximate Dimension: 4800(L) x 900(D) x 2425(H) mm, Approximate weight : 3900 kg		
A.2.35	ESP A/C & VENT. MCC #2TB, 400 A	-	1 No.
	Approximate Dimension: 4800(L) x 900(D) x 2425(H) mm, Approximate weight : 3900 kg		
A.2.36	MISC. SERVICE MCC#0QA, 630 A	1 No.	-
	Approximate Dimension: 11300(L) x 900(D) x 2425(H) mm, Approximate weight : 9600 kg		
A.2.37	MISC. SERVICE MCC#0QB, 630 A	-	1 No.
	Approximate Dimension: 11300(L) x 900(D) x 2425(H) mm, Approximate weight : 9600 kg		
A.2.38	BOTTOM ASH SILO MCC #0SA, 400 A	1 No.	-
	Approximate Dimension: 3200(L) x 900(D) x 2425(H) mm		
	Approximate weight : 2600 kg		
A.2.39	WORKSHOP ACDB #0SB, 630 A	1 No.	-
	Approximate Dimension: 6900(L) x 900(D) x 2425(H) mm		
	Approximate weight : 6150 kg		
A.2.40	CCR AC MCC #0TA, 1600 A	1 No.	-
	Approximate Dimension: 10100(L) x 1300(D) x 2425(H) mm		
	Approximate weight : 8750 kg		

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A.2.41	Service Build. AC & VENT. MCC #0TB, 1000 A	1 No.	-
	Approximate Dimension: 11500(L) x 900(D) x 2425(H) mm		
	Approximate weight : 9150 kg		
A.2.42	CPU MCC #0WA, 400 A	1 No.	-
	Approximate Dimension: 6400(L) x 900(D) x 2425(H) mm		
	Approximate weight : 5200 kg		
A.2.43	RAW WATER P/H MCC #0WC, 1000 A	1 No.	-
	Approximate Dimension: 7700(L) x 900(D) x 2425(H) mm		
	Approximate weight : 6700 kg		
A.2.44	ETP MCC #0WD, 400 A	1 No.	-
	Approximate Dimension: 6400(L) x 900(D) x 2425(H) mm		
	Approximate weight : 5200 kg		
A.2.45	CW & Electro Chlorination MCC #0DH, 3000 A	1 No.	-
	Approximate Dimension: 7200(L) x 1600(D) x 2425(H) mm		
	Approximate weight : 6050 kg		
A.2.46	Compressor House MCC #0SC, 400A	1 no.	-
	Approximate Dimension: 4800(L) x 900(D) x 2425(H) mm		
	Approximate weight : 3900 kg		
A.2.47	Data Concentrator alongwith PC, Laptop, Printer & other accessories	1 set.	1 set.
	Approximate dimensions : 800(L) x 1000(D)x 2400(H) mm		
	Approximate weight : 400 kg		
A.2.48	240 V AC MCCB DBs (Wall mounted)	10 nos.	08 nos.
A.2.49	220 V DC FUSE DBs (Wall mounted)	7 nos.	05 nos.
A.2.50	Local motor starter (Upto 5.5 KW)	90 Nos.	70 Nos.
A.3.0	PUSH BUTTON STATIONS (Clause 1.7.1.3)		
A.3.1	Emergency Stop PBs	450 Nos.	400 Nos.
A.3.2	Start and Stop PBs	117 Nos.	70 Nos.
A.3.3	Flame proof Emergency stop PBs	12 Nos.	08 Nos.
A.3.4	Flame proof start and stop PBs	09 Nos.	06 Nos.

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A.4.0	BATTERY (<i>Clause 1.7.1.5</i>)		
A.4.1	220 V DC, 820 AH capacity, 1.14 ECV, Ni-Cd fibre plate low discharge battery , made up of around 170 cells, housed in 2 step 1 tier MS Rack, along with intr cell connectors, inter pole connectors, inter row connectors, 1 set of battery health monitoring system and cabling for health monitoring system (Battery health monitoring system comprises of individual health monitoring of cells, necessary hardware, software and one laptop) Each battery set consists of 02 nos. of racks. Approx. dimensions of each Rack : 8605 (L) x 646 (W) x 844 (H) mm Approx. dimensions and weight of each cell : 260(L)x195(D)x405(H) mm ; 50 Kg (with electrolyte)	4 set	4 set
A.5.0	BATTERY CHARGERS(<i>Clause 1.7.1.5</i>)		
A.5.1	400A, 220V DC Float-cum-boost chargers with Battery Isolation box 02 nos. for each unit and Discharge resistor bank 01 no. for each unit. Approximate total size and weight of Charger: 2053(L) x1200(D) x 2200(H) mm, Weight : 2000 kg approx. Approximate size of Battery Isolation Box: 700(L) x 375(D) x 1250(H), Weight : 100 kg approx. Approximate size of Discharge Resistor Bank : 1300(L) x 1000(D) x 2000(H) mm, Weight : 500 kg approx.	3 Set	3 Set
A.6.0	Hot Dipped Galvanised Cable Trays complete with Coupler Plates, Fasteners , Clamps and Covers complete with formed channel, Pipe, GI Flat, bolts with nuts & Fixing hardware (<i>Clause 1.7.1.1</i>)		
A.6.1	Ladder type 600 mm wide	17250 Mtrs	17250 Mtrs
A.6.2	Ladder type 450 mm wide	2750 Mtrs	2750 Mtrs
A.6.3	Ladder type 300 mm wide	10250 Mtrs	10250 Mtrs
A.6.4	Ladder type 150 mm wide	2750 Mtrs	2750 Mtrs
A.6.5	Ladder type 100 mm wide	750 Mtrs	750 Mtrs
A.6.6	Perforated Type, 600 mm wide	11000 Mtrs	11000 Mtrs

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A.6.7	Perforated Type, 450 mm wide	1500 Mtrs	1500 Mtrs
A.6.8	Perforated Type, 300 mm wide	7250 Mtrs	7250 Mtrs
A.6.9	Perforated Type, 150 mm wide	750 Mtrs	750 Mtrs
A.6.10	Perforated Type, 100 mm wide	500 Mtrs	500 Mtrs
A.6.11	Hot dip galvanised MS sheet (14 SWG) for covering of cable shaft (will be supplied in size of 2000mm x 1000mm min.)	550 sq.mts	550 sq.mts
A.7.0	LAYING OF LT POWER CABLES (<i>Clause 1.7.1.2</i>) 1.1 KV Grade, Aluminium conductor, XLPE insulated armoured cable.		
A.7.1	1 C X 35 sq. mm	5,000 Mtrs	5,000 Mtrs
A.7.2	1 C X 400 sq. mm	12,000 Mtrs	12,000 Mtrs
A.7.3	1 C X 630 sq. mm	22,000 Mtrs	22,000 Mtrs
A.7.4	2 C X 25 sq. mm	4,000 Mtrs	4,000 Mtrs
A.7.5	2 C X 70 sq. mm	1,000 Mtrs	1,000 Mtrs
A.7.6	2 C X 95 sq. mm	2,000 Mtrs	2,000 Mtrs
A.7.7	2 C X 120 sq. mm	4,000 Mtrs	4,000 Mtrs
A.7.8	2 C X 185 sq. mm	2,000 Mtrs	2,000 Mtrs
A.7.9	3 C X 25 sq. mm	18,000 Mtrs	18,000 Mtrs
A.7.10	3 C X 50 sq. mm	5,000 Mtrs	5,000 Mtrs
A.7.11	3 C X 95 sq. mm	5,000 Mtrs	4,000 Mtrs
A.7.12	3 C X 150 sq. mm	3,000 Mtrs	2,000 Mtrs
A.7.13	3 C X 240 sq. mm	5,000 Mtrs	4,000 Mtrs
A.7.14	3.5 C X 25 sq. mm	10,000 Mtrs	10,000 Mtrs
A.7.15	3.5 C X 50 sq. mm	13,000 Mtrs	13,000 Mtrs
A.7.16	3.5 C X 95 sq. mm	2,000 Mtrs	1,000 Mtrs
A.7.17	3.5 C X 185 sq. mm	2,000 Mtrs	1,000 Mtrs
A.7.18	3.5 C X 300 sq. mm	2,000 Mtrs	2,000 Mtrs
A.8.0	LAYING OF LT XLPE POWER CABLES (<i>Clause 1.7.1.2</i>) 1.1 KV Grade, Copper conductor, XLPE insulated armoured cable.		
A.8.1	1C X 95 sq.mm, Copper conductor, armoured	50 Mtrs	50 Mtrs
A.8.2	1C X 109/120 sq.mm, Copper conductor, armoured	50 Mtrs	50 Mtrs
A.8.3	1CX300 sq.mm copper conductor, armoured	1750 Mtrs	1750 Mtrs
A.8.4	2CX95 sq.mm copper conductor, armoured	1500 Mtrs	1500 Mtrs
A.8.5	2CX185 sq.mm copper conductor, armoured	750 Mtrs	750 Mtrs
A.8.6	3Cx50 sq.mm copper conductor, armoured	750 Mtrs	750 Mtrs
A.8.7	3CX95 sq.mm copper conductor, armoured	500 Mtrs	500 Mtrs

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A.9.0	LT POWER CABLE END TERMINATIONS (Clause 1.7.1.2)		
A.9.1	1 C X 35 sq. mm	300 nos	260 nos
A.9.2	1 C X 95 sq. mm	20 nos	20 nos
A.9.3	1 C X 400 sq. mm	600 nos	400 nos
A.9.4	1 C X 630 sq. mm	650 nos	450 nos
A.9.5	2 C X 25 sq. mm	300 nos	200 nos
A.9.6	2 C X 70 sq. mm	50 nos	50 nos
A.9.7	2 C X 95 sq. mm	30 nos	30 nos
A.9.8	2 C X 120 sq. mm	50 nos	50 nos
A.9.9	2 C X 185 sq. mm	15 nos	20 nos
A.9.10	3 C X 25 sq. mm	150 nos	100 nos
A.9.11	3 C X 50 sq. mm	120 nos	60 nos
A.9.12	3 C X 95 sq. mm	80 nos	15 nos
A.9.13	3 C X 150 sq. mm	25 nos	15 nos
A.9.14	3 C X 185 sq. mm	10 nos	10 nos
A.9.15	3 C X 240 sq. mm	100 nos	50 nos
A.9.16	3.5 C X 25 sq. mm	100 nos	30 nos
A.9.17	3.5 C X 50 sq. mm	400 nos	200 nos
A.9.18	3.5 C X 95 sq. mm	70 nos	60 nos
A.9.19	3.5 C X 185 sq. mm	50 nos	50 nos
A.9.20	3.5 C X 300 sq. mm	70 nos	60 nos
A.9.21	1CX300 sq.mm	80 nos	80 nos
A.10.0	1.1 KV LT XLPE CABLE STRAIGHT THROUGH JOINT KIT (Clause 1.7.1.2)		
A.10.1	1CX400 Sq.mm, Armoured	16 Nos	16 Nos
A.10.2	1CX630 Sq.mm, Armoured	06 Nos.	06 Nos.
A.10.3	2CX25 Sq.mm, Armoured	06 Nos	06 Nos
A.10.4	3.5X95 Sq.mm, Armoured	06 Nos	06 Nos
A.11.0	LAYING AND TERMINATION OF LT POWER / CONTROL CABLES , (Clause 1.7.1.2) 1.1 KV Grade, Copper / Aluminium conductor, XLPE / PVC insulated armoured cable.		
A.11.1	2 C X 10 sq. mm, Aluminium	5,000 Mtrs	5,000 Mtrs
A.11.2	3 C X 16 sq. mm, Aluminium	24,000 Mtrs	24,000 Mtrs
A.11.3	4 C X 16 sq. mm, Aluminium	5,000 Mtrs	4,000 Mtrs
A.11.4	2 C x 2.5 Sq. mm, Copper	65,000 Mtrs	60,000 Mtrs
A.11.5	3 C X 2.5 sq. mm, Copper	91,500 Mtrs	89,500 Mtrs
A.11.6	5 C X 2.5 sq. mm, Copper	33,000 Mtrs	33,000 Mtrs

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A.11.7	7C X 2.5 sq. mm, Copper	3000 Mtrs	2000 Mtrs
A.11.8	12 C X 2.5 sq. mm, Copper	23,000 Mtrs	22,000 Mtrs
A.11.9	2 C X 1.5 sq. mm, Copper	100 Mtrs	100 Mtrs
A.11.10	5 C X 1.5 sq. mm, Copper	100 Mtrs	100 Mtrs
A.11.11	7 C X 1.5 sq. mm, Copper	100 Mtrs	100 Mtrs
A.11.12	10 C X 1.5 sq. mm, Copper	100 Mtrs	100 Mtrs
A.11.13	12 C X 1.5 sq. mm, Copper	50 Mtrs	50 Mtrs
A.11.14	14 C X 1.5 sq. mm, Copper	50 Mtrs	50 Mtrs
A.11.15	16 C X 1.5 sq. mm, Copper	50 Mtrs	50 Mtrs
A.12.0	EARTHING / LIGHTING PROTECTION MATERIALS (Clause 1.7.1.2)		
A.12.1	75 x 10 mm GS Flats	10700 Mtrs	10600 Mtrs
A.12.2	50 x 6 mm GS Flats	10000 Mtrs	10000 Mtrs
A.12.3	25 x 3 mm GS Flats	1666 Mtrs	1666 Mtrs
A.12.4	8 SWG GI Wire	3100 Mtrs	3100 Mtrs
A.12.5	20 mm Dia, 1-Meter long hot dip GS rod for vertical air termination including erection of test links with 150x50x6 thick hot dip galvanised GS Flat with Box . (Vertical air terminal and test links with GS flat and Box will be issued by BHEL, free of cost)	125 Nos.	113 Nos.
A.12.6	<u>TREATED EARTH PIT : Construction of treated earth pits which includes-</u> Supply and Installation of heavy duty (perforated) 45 NB, 2 Mtr long, GS pipe with removable cap with wire mesh and 40mm dia, 3 Mtr long, MS rod , including supply and filling of charcoal, salt, sand etc., as per BHEL drawing. (40mm dia MS rod will be issued by BHEL in 10 TO 12 mtr running lengths, free of cost)	150 Nos.	100 Nos.
A.13.0	STRUCTURAL STEEL (Clause 1.7.1.4)		
A.13.1	ISA-50X50X6	100 MT	100 MT
A.13.2	ISMC 100	45 MT	45 MT
A.13.3	ISMC 150	138 MT	137 MT
A.14.0	CONDUITS RIGID/ FLEXIBLE (Clause 1.7.1.4)		
A.14.1	GI rigid conduit - 2"dia	100 Mtrs	100 Mtrs
A.14.2	GI rigid conduit- 3"dia	100 Mtrs	100 Mtrs
A.15.0	ELECTRICAL COMMISSIONING of the following erected by Mechanical Contractor (Clause 1.7.1.8)		
A.15.1	LT Motors	600 Nos. \$	300 Nos. \$
A.15.2	Electrical actuators for valves & dampers	400 Nos. \$	400 Nos. \$

TECHNICAL CONDITIONS OF CONTRACT (TCC)

A.15.3	Hoists / cranes / monorail	60 Nos. \$	30 Nos. \$
A.15.4	Exciter dryer / heater	03 No. \$	03 No. \$
A.15.5	Generator Air Drier	01 No. \$	01 No. \$
A.15.6	CO ₂ Vaporizer	01 No. \$	01 No. \$
A.15.7	Exciter Stroboscope	01 No. \$	01 No. \$
A.15.8	Control Panel for Hydrogen Dosing System (skid mounted)	01 No. \$	01 No. \$
A.15.9	Control Panel for Ammonia Dosing System (skid mounted)	01 No. \$	01 No. \$
A.15.10	Control Panel for NAOH Dosing System (skid mounted)	01 No. \$	01 No. \$
A.15.11	Control Panel for Phosphate Dosing System (skid mounted)	01 No. \$	01 No. \$
	\$ Rate to be quoted for commissioning only		
B.	BHEL - TRICHY SCOPE		
B.1.0	Soot Blower MCC Size: 15000(L) x 900 x 2400mm; Wt : 11950 kg approx.	1 No.	1 No.
B.2.0	HEAT TRACING SYSTEM		
B.2.1	Fuel oil Electrical Heat Tracer Panel along with 75 KVA transformer Size: 4600(L) x 850(D) x 2100mm; Wt : 2000 kg approx.	01 No.	01 No.
B.2.2	Electrical Heat Tracer Tape along with accessories like power connector, tee connector, splice connector, end connector, adhesive tapes, pipe straps, thermostats (approx 30 no per Unit), Mounting clamps, etc. (Clause 1.7.1.2)	1250 Mtrs	750 Mtrs
B.3.0	FTP Local starter panels Size: 650 x 300 x 1000 mm; Wt: 25 kg each	2 Nos.	2 Nos.
B.4.0	D.C. Starter panel for Scanner air fan Size: 900 x 375 x 1120, Wt :50 kg	1 No.	1 No.
B.5.0	Junction Box for APH SB Local start/stop push button	2 Nos.	2 Nos.
B.6.0	Hot Dipped Galvanised Cable Trays, complete with coupler plates, fasteners etc.		
B.6.1	Perforated tray 100 mm wide	1000 Mtrs	1000 Mtrs

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B.7.0	LAYING & TERMINATION OF LT POWER / CONTROL CABLES-1.1 KV Grade, XLPE / PVC insulated, armoured Copper / Aluminium cable. (Clause 1.7.1.2)		
B.7.1	3CX6 sq.mm, Aluminium conductor, Armoured	2300 Mtrs	2300 Mtrs
B.7.2	3 C X 2.5 sq. mm, Copper conductor, Armoured	57500 Mtrs	57500 Mtrs
B.7.3	2 C x 2.5 Sq. mm, Copper conductor, Armoured	5500 Mtrs	5500 Mtrs
B.7.4	5 C x 2.5 Sq. mm, Copper conductor, Armoured	750 Mtrs	750 Mtrs
B.7.5	7 C x 2.5 Sq. mm, Copper conductor, Armoured	16500 Mtrs	16500 Mtrs
B.7.6	10 C x 2.5 Sq. mm, Copper conductor, Armoured	27000 Mtrs	27000 Mtrs
B.7.7	4CX2.5 sq.mm, Copper conductor, Armoured	15600 Mtrs	15600 Mtrs
B.7.8	19CX1.5 sq.mm, Copper conductor, Armoured	4500 Mtrs	4500 Mtrs
B.8.0	STRUCTURAL STEEL (Clause 1.7.1.4)		
B.8.1	CHANNEL , ISMC 100	5 MT	5 MT
B.8.2	ANGLE, ISA, 40 X 40X 5	2 MT	2 MT
B.9.0	ELECTRICAL COMMISSIONING of the following erected by Mechanical Contractor (Clause 1.7.1.8)		
B.9.1	Soot Blowers (LRSB / WB/AH etc) including commissioning of 2 Nos. motors, setting of limit switches etc.	132 Nos. \$	132 Nos. \$
	\$ Rate to be quoted for commissioning only.		
C.	BHEL – RANIPET SCOPE		
C.1.0	ESP CONTROL PANELS / MCC (Clause 1.7.1.5)		
C.1.1	Auxiliary Control Panel	4 Nos.	4 Nos.
	Overall dimension:12787(L) x 1000(W) x 2450(H) mm		
	Approximate Weight : 13000 kg for each Panel		
C.1.2	LT Main switch board (LTMSB)	4 Nos.	4 Nos.
	Overall dimensions-9500(L) x 1700(W) x 2525(H) mm		
	Approximate Weight - 8550 kg for each board		
C.1.3	Electronic Control Panel with Bapcon controller (01 no. per ECP) shall be supplied loose for mounting in the panel.	80 Nos.	80 Nos.
	Size : 600 x 550 x 1900 mm		
	Approximate Weight : 200 kg		
C.1.4	IOS panel with stand alone PC with colour monitor, Data logger PC with colour monitor, printers and other accessories etc.	1 Set	1 Set
	Size : 1000 x 650 x 2050 mm; 200 kg (approx.)		

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C.1.5	Rapper Control Panel with Rapcon controllers (02 nos per RCP) shall be supplied loose for mounting in the panel.	4 Nos.	4 Nos.
	Size : 1000 x500 x 2050 mm		
	Approximate Weight : 200 kg		
C.1.6	RO-DM MCC	1 No.	-
	Overall dimension : 21000(L) x1700(D) x 2400(H) mm		
	Approximate Weight : 18000 kg		
C.1.7	Ash level indicator with probe	160 Nos.	160 Nos.
	Weight of ALI: Approx 7.5 kg per ALI		
C.1.8	Laying and dressing of 25mm dia GI Flexible Metallic Conduit with fixing hardwares, laying of PTFE shielded signal cable and 1.0 sqmm PVC insulated copper wire for Ash level indicating system (Quantity indicated is for each item)	2400 Mtrs	2400 Mtrs
C.2.0	JUNCTION BOXES / LOCAL START STOP PUSH BUTTONS (Clause 1.7.1.3)		
C.2.1	Local Start Stop Push Buttons (for Rapping Motors)	260 Nos.	168 Nos.
	Size: 180 x 100 x 250 mm; approximate wt 2.5 kg each		
C.2.2	Junction Boxes for hopper heaters	80 Nos.	80 Nos.
	Size: 600 x 278 x 515 mm; approximate wt 15 kg per JB		
C.2.3	Junction Boxes for support insulator heaters, shaft insulator heaters	24 Nos.	24 Nos.
	Size: 450 x 150 x 300 mm; approximate wt 15 kg each		
C.2.4	Junction Boxes for start stop PB , hopper thermostat, ALI, Opacity	50 Nos.	50 Nos.
	Size: 250 x 150 x 400 mm; approximate wt 12 kg each		
C.3.0	Hot Dipped Galvanised Cable Trays, complete with coupler plates, fasteners etc. (Clause 1.7.1.1)		
C.3.1	Ladder type 600 mm wide	2825 Mtrs	2625 Mtrs
C.3.2	Ladder type 450 mm wide	1000 Mtrs	1000 Mtrs
C.3.3	Ladder type 300 mm wide	3950 Mtrs	3750 Mtrs
C.3.4	Ladder type 150 mm wide	6290 Mtrs	5250 Mtrs
C.3.5	Perforated type 600 mm wide	200 Mtrs	-
C.3.6	Perforated type 150 mm wide	300 Mtrs	-

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C.4.0	LAYING OF LT POWER CABLES-1.1 KV Grade, Aluminium conductor, PVC insulated Armoured cable (Clause 1.7.1.2)		
C.4.1	2 C X 120 sq. mm	66,000 Mtrs	66,000 Mtrs
C.4.2	3 C X 25 sq. mm	5900 Mtrs	-
C.4.3	3 C X 70 sq. mm	2600 Mtrs	2600 Mtrs
C.4.4	3 C X 95 sq. mm	725 Mtrs	-
C.4.5	3 C X 120 sq. mm	7500 Mtrs	7500 Mtrs
C.5.0	TERMINATION OF LT POWER CABLES (Clause 1.7.1.2)		
C.5.1	2 C x 120 sqmm	640 nos.	640 nos.
C.5.2	3 C X 25 sq. mm	40 nos	-
C.5.3	3 C x 70 sqmm	32 no	32 nos
C.5.4	3 C X 95 sq. mm	40 nos	-
C.5.5	3 C x 120 sqmm	96 nos.	96 nos.
C.6.0	LAYING AND TERMINATION OF LT POWER/ CONTROL CABLES (Clause 1.7.1.2) 1.1 KV Grade, PVC insulated, Unarmoured / Armoured, Aluminium / Copper cable.		
C.6.1	3 C X 6 sq. mm, Aluminium, Armoured	22,000 Mtrs	22,000 Mtrs
C.6.2	3 C X 10 sq. mm, Aluminium, Armoured	1000 Mtrs	1000 Mtrs
C.6.3	3 C X 2.5 sq. mm, Copper, Armoured	63550 Mtrs	57,000 Mtrs
C.6.4	7 C X 2.5 sq. mm, Copper, Armoured	8700 Mtrs	-
C.6.5	14C X 2.5 sq. mm, Copper, Armoured	41,000 Mtrs	41,000 Mtrs
C.6.6	2 C X 2.5 sq. mm, Copper, Unarmoured	19,000 Mtrs	19,000 Mtrs
C.6.7	4 C X 1.5 sq. mm, LT Screened copper armoured cable,	31,000 Mtrs	31,000 Mtrs
C.7.0	EARTHING MATERIALS (Clause 1.7.1.2)		
C.7.1	GS Flat 50 x 6 mm	6500 Mtrs	4000 Mtrs
C.7.2	GS Flat 30 x 5 mm	3900 Mtrs	3500 Mtrs
C.7.3	GI wire 8 SWG	16000 mtrs	15000 Mtrs
C.8.0	STRUCTURAL STEEL (Clause 1.7.1.4)		
C.8.1	ISA 50 X 50 X 6	26 MT	23 MT
C.8.2	ISMC 75 X 40	23 MT	17 MT
C.8.3	ISMC 150	4 MT	4 MT
C.9.0	CONDUITS(Claude 1.7.1.4)		
C.9.1	GI Rigid conduit - 2" Dia	490 Mtrs.	-
C.9.2	GI Rigid conduit - 4" Dia	315 Mtrs.	-

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C.10.0	ELECTRICAL COMMISSIONING <i>of the following erected by Mechanical Contractor (Clause 1.7.1.8)</i>		
C.10.1	LT Drives of ESP	168 Nos \$	168 Nos \$
C.10.2	Hoists/cranes/monorail	4 Nos \$	4 Nos \$
C.10.3	Testing, Termination and dressing of Heating Elements for Hopper (Panel Type)	1920 Sets \$	1920 Sets \$
C.10.4	Testing Heating elements for support insulator heater	320 sets \$	320 sets \$
C.10.5	Testing Heating elements for shaft insulator heater	80 Nos \$	80 Nos \$
C.10.6	Testing Thermostats for hopper heaters.	80 Nos \$	80 Nos \$
C.10.7	Testing Thermostat for support insulators	8 Nos \$	8 Nos \$
	\$ Rate to be quoted for commissioning only.		
D.	BHEL-EDN SCOPE		
D.1.0	Unit Control Panel <i>(Clause 1.7.1.5)</i>	1 No.	1 No.
	Size 1016(L) x 1000 (D) x 2355 (H) mm; Approx. weight-1200 kg		
D.2.0	Electrical Control Panel	1 No.	1 No.
	Size 2072 (L) x 1000(D) x 2355(H) mm; Approx. weight-1200 kg		
E.	BHEL-HYDERABAD SCOPE		
E.1.0	TD BFP PANELS <i>(Clause 1.7.1.5)</i>		
E.1.1	D.C. Starter Panels with Resistance Box For EOPs	2 Nos.	2 Nos.
	Approximate size : 800 x 800 x 2280 mm; Wt: 800 kg each		
E.1.2	Lube Oil Purification Equipment Panel <i>(Clause 1.7.1.8)</i>	1 No.\$	1 No.\$
	\$ Rate to be quoted for commissioning only.		
F	BHEL-HARIDWAR SCOPE		
F.1.0	D.C. Starter Cabinet with Resistance box for DC Seal Oil Motor <i>(Clause 1.7.1.5)</i>	1 No.	1 No.
	Approximate size:1000 x 800 x 2200 mm; Wt :450 kg		
F.2.0	D.C. Starter Panels with Resistance Box For EOPs <i>(Clause 1.7.1.5)</i>	1 No.	1 No.
	Approximate size & Wt.: 800 x 800 x 2280 mm; 800 kg		

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	Approximate size of resistance box: 800 x 800 x 1000 mm; Wt : 400 kg approx.		
F.3.0	Lube Oil Purification Equipment Panel (<i>Clause 1.7.1.8</i>)	1 No.\$	1 No.\$
	\$ Rate to be quoted for commissioning only.		
F.4.0	LAYING AND TERMINATION OF LT CONTROL CABLES(<i>Clause 1.7.1.2</i>) 1.1 KV Grade, XLPE / PVC insulated Armoured , Copper cable.		
F.4.1	5 C x 2.5 Sq. mm	4000	3000
G.	BHEL- ISG SCOPE		
G.1.0	DIESEL GENERATOR SET (<i>Clause 1.7.1.5</i>) 1875 KVA, 3 phase, 415V skid-mounted diesel generator set with Fuel Tank, Fuel piping (approx. 21 Mtrs), Lubricating system, Air Intake System, Exhaust system (approx. 75 Mtrs of 250 mm dia pipe), Governing System, battery operated starting means etc., engine coupled together to the alternator and mounted on a sturdy, fabricated welded construction, channel iron base frame, Structural column for supporting exhaust pipe, Acoustic Enclosure etc.	2 set	1 set
	The alternator is supplied with alternator phase and neutral side terminal boxes, complete with excitation system with built in AVR panel mounted on alternator.		
	The other loose supplied items include		
	AMF Panel: 1Set (Common for three DG sets)		
	Size : 2700mm(W) x 750mm (D) x 2300mm(H); wt 800 kg approx.		
	Aux. Distribution Board: 1 Set (Common for three DG sets)		
	Size: 4500mm(W) x 2475mm(H) x 600mm(D); Approximate wt 1000 kg approx.		
	Load Bank - 01 Set (Common for three DG sets)		
	Size :5750mm(W) x 1700mm(D) x 2400mm(H); Weight : 3000 kgs approx.		
	Breaker Panel with EDO breakers-01 Set (Common for three DG sets)		
	Size: 9000(W)x1250(D)x2474(H) Weight :1500 kg approx.		

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	24V Float Cum Boost Charger with Accessories - 2 set per DG		
	Size 700mm(W) x 400mm(D) x 1300mm(H), Weight - 250 Kg approx.		
	360 AH, 12V, Battery - 2 set per DG		
	Fuel tank 990 litre - 01no per DG, Size : 1250(L) x 1250(H) x 750(D), Dry Weight : 200 kg approx.		
	Storage tank 10 Kilo litres - 01 no. (Common tank for three DG sets), Size : 1940 mm(Dia)x3750mm(H), Dry Weight : 1750 kg approx.		
	Fuel transfer pump with associated piping & valves - 3nos for three DG sets.		
	Neutral Grounding Resistor with isolator- 1 set per DG		
	Size: 450mm(W) x 625mm(D) x 865mm(H) Weight : 150 Kg approx.		
	Local Push Button Stations - 05 Nos per DG set		
	Overall dimensions of each DG set: 6050(L) x 2270(W) x 2589(H) mm		
	Weight of each DG Set: 15500 kg		
	Fabrication and erection of Supporting structure for exhaust etc. - approx 10 MT per DG.		
	Cabling work & earthing of DG set (internal) will be part of the above work. No extra payment for the same.		
H.	BHEL-PIPING CENTRE SCOPE		
H.1.0	HEAT TRACING SYSTEM		
H.1.1	Fuel oil Electrical Heat Tracer Panel along with 100 KVA Transformer. <u>Approx. Total size and weight</u> Size: 4600(L) x 850(D) x 2100mm; Wt : 2000 kg	01 No.	-
H.1.2	Electrical Heat Tracer Tape along with accessories like power connector, tee connector, splice connector, end connector, adhesive tapes, pipe straps, thermostats(approx 15), Mounting clamps, etc. (Clause 1.7.1.2)	2000 Mtrs	-
H.2.0	CABLES		
	LT POWER/ CONTROL CABLES-1.1 KV Grade, XLPE / PVC insulated, armoured Copper / Aluminium cable. (Clause 1.7.1.2)		
H.2.1	2 C X 4 sq. mm, Copper cable, laying and termination	800 Mtrs	-

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H.2.2	2 C X 16 sq. mm, Aluminium cable, laying and termination	600 Mtrs	-
H.2.3	2 C X 35 sq. mm, Aluminium cable, laying	1000 Mtrs	-
H.2.4	2 C X 35 sq. mm, Aluminium cable, termination	10 Nos.	-
H.2.5	2 C X 70 sq. mm, Aluminium cable, laying	3500 Mtrs	-
H.2.6	2 C X 70 sq. mm, Aluminium cable, termination	20 Nos.	-
H.2.7	2 C X 95 sq. mm, Aluminium cable, laying	1500 Mtrs	-
H.2.8	2 C X 95 sq. mm, Aluminium cable, termination	10 Nos.	-
H.2.9	3C X 2.5 sq.mm, Copper cable, laying and termination	5000 Mtrs	-

NOTE TO BOQ:

1. The BOQ Ref. no given above may be linked with the BOQ Ref no in Price bid.
2. For the purpose of running bill payment, the clause no applicable for the item is shown within bracket in italics.
3. The Price bid contains the consolidated list of BOQ with brief description of items.
4. Rates are to be filled only in the Price bid.
5. Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document.
6. The quantity indicated in the BOQ / 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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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.
- 1.10.3 The contractor shall have valid ELECTRICAL CONTRACTOR LICENSE to carry out the scope / job mentioned in the BOM.
- 1.10.4 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.
- 1.10.5 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 and Field quality plans of BHEL.
- 1.10.6 The contractor shall co-ordinate and provide assistance 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.
- 1.10.7 The contractor shall arrange necessary statutory inspections and obtain certificates for the installation work at his cost. Any modification work required by inspector shall be attended by the contractor at his cost.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.10.8 If any item or equipment not covered but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.
- 1.10.9 The scope of specification covers the installation, testing and commissioning of the erected equipment/ instrument along with accessories as detailed in Bill of Materials.
- 1.10.10 The contractor shall have valid Electrical License, as required, to carry out the Electrical Works. All the necessary certificates and licenses required to carryout this work are to be arranged by the contractor expeditiously at his cost.
- 1.10.11 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.
- 1.10.12 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.
- 1.10.13 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.
- 1.10.14 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.
- 1.10.15 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.10.16 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.
- 1.10.17 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.
- 1.10.18 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.
- 1.10.19 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.
- 1.10.20 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.
- 1.10.21 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.
- 1.10.22 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.
- 1.10.23 Wherever erection sequences are furnished by BHEL , the contractor shall follow the same sequence.
- 1.10.24 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.

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- 1.10.25 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
- 1.10.26 Contractor has to work in close co-ordination with other erection agencies 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.
- 1.10.27 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.
- 1.10.28 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.
- 1.10.29 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.
- 1.10.30 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.31 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2000 Standards.
- 1.10.32 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.
- 1.10.33 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.

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- 1.10.34 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.35 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.
- 1.10.36 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.
- 1.10.37 The contractor shall have valid Electrical License, as required, to carry out the Electrical Works. 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.
- 1.10.38 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.
- 1.10.39 All the equipments / material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.
- 1.10.40 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.
- 1.10.41 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.
- 1.10.42 **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.

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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.

1.10.43 ELECTRICAL INSPECTORATE'S APPROVAL:

1.10.43.1 Contractor is responsible for getting Electrical Inspector/statutory authority's approval for all electrical installation covered in his scope. This also includes the Electrical equipments that are erected by mechanical contractor for which commissioning assistance is to be provided by the Electrical contractor.

1.10.43.2 For getting electrical inspector approval, contractor shall arrange the following:

- a) Erection Completion certificate
- b) Details of Equipments (specification)
- c) Test results conducted at site.
- d) Any other documents as required by statutory authority.

1.10.43.3 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.

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

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

1.10.44 MANPOWER REQUIREMENT

1.10.44.1 Resident Engineer should have a minimum qualification of Engineering Degree or Diploma in Engineering with 15 years of experience in Thermal Power Station.

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- 1.10.44.2 Supervisor should have a minimum qualification of Diploma in Engineering or a graduate with 5 to 10 years of experience in Thermal Power Station.
- 1.10.44.3 Lab Technicians should have experience in Thermal Power Stations.
- 1.10.44.4 Contractor should have one Store Keeper and one Transport Supervisor for the safe transportation of materials.
- 1.10.44.5 Manpower requirement for Erection and Commissioning shall as follows:
- i) There shall be a Resident manager as Site-In- Charge at site, under whom there shall be 3 erection engineers who shall take care of the erection activities.
 - ii) 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 the relevant Clause Besides, there shall be separate engineers for Planning, Safety and Quality.
 - iii) 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 shall not be an excuse for extension of completion date.
 - iv) All instructions from BHEL / Customer shall 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
 - v) 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.
 - vi) 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 shall not be allowed to suffer delay on this account.
 - vii) 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.

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- viii) 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.
- ix) The contractor shall ensure that replacement for such persons removed from site are provided immediately and the work is not allowed to suffer delay on that account.

1.10.46 DOCUMENTATION

1.10.46.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval

- a) Bar chart covering planned activities at site
- b) Detailed organization chart
- c) Details of T&P available with contractors with documents proofs.

1.10.46.2 The following information shall be furnished by the bidder after testing and inspection:

Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan.

1.10.46.3 As built drawings:

After successful completion, testing and commissioning of installation work, Purchaser's drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor as agreed for the project.

1.10.46.4 VOLUME-IA PART- II CHAPTER -2 of this booklet contains general guidelines for Erection and Commissioning of Electrical systems

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PART –I CHAPTER -XI FOUNDATIONS AND GROUTING

- 1.11.1 Foundation for the equipments to be erected (DG set etc.) 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 25 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.

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- 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 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 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 WORK-DETAILED

1.13.1 SCOPE OF WORK FOR LT BUSDUCTS

1.13.1.1 LT Bus ducts shall be of Non-segregated Phase Type, rectangular shape, made out of Aluminium enclosure with Aluminium busbar. The Aluminium busbars shall be supported with insulators. LT Busducts are used for connecting LT Transformers and PCC / MCC and will be supplied in different sectional lengths as per layout.

1.13.1.2 BHEL will supply necessary busduct supporting materials like GI or MS angle/channels along with bus ducts. The support materials supplied may be either prefabricated or of standard length and the same shall be fabricated and installed as per site requirements.

1.13.1.3 The scope of work includes Receipt from BHEL stores/yards, loading & unloading all the bus duct materials and accessories and equipment as indicated in the BOM and relevant drawings at the area where the busducts are to be erected, inspection, installation of all the materials, testing and commissioning of total busduct, painting and handing over. Minor civil works like chipping, grouting of bus duct support columns, including supply of grouting material is also included in the scope of work.

1.13.1.4 The unit rate quoted for E&C of bus ducts shall include fabrication and installation and painting of its supports (For MS supports if any). No separate rate shall be paid applicable for the same.

1.13.1.5 If there is any mismatch or inadequacy of the holes on the bus duct flange, the same shall be drilled at site to facilitate matching of bus duct flange with Transformer or PCC/MCC flanges without any extra cost.

1.13.1.6 *Length of LT Busducts mentioned in the BOQ is approximate only and payment shall be made as per actual length erected.* Variations in width, height and weight (including weight of support structure) will not be considered for payment.

1.13.1.7 Bus ducts have to be painted with one coat of paint after installation.

1.13.1.8 DETAILED SCOPE OF WORK FOR LT BUS DUCT

- a) Placement of embedment and erection and alignment of steel support structures, Assembly of busduct, Fixing of wall bushings/wall frame assembly, Providing earthing connections. Minor civil work such as chipping and drilling holes on concrete if necessary, enlarging of pockets in concrete pedestals and grouting of busduct support structures including supply of materials required for civil works. Grouting of bus duct and support structures and connecting to earth grid /earth pits as detailed in the relevant bus duct drawings.

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- b) 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)
- c) Carrying out required level of cleaning inside as well as outside of the bus duct for the purpose of conducting high voltage test before commissioning of the unit. Every bus duct piece has to be tested for IR value (for 415 Volts bus ducts) and both IR and HV test at rated voltage (For voltage levels above 415 Volts) before erection. This is in addition to the final IR value and HV testing before charging. After long shut downs, the IR value / HV tests will have to be carried out before charging.
- d) Extension of embedment if required and erection of required supports structures as detailed in the drawing.
- e) Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound will be used for joints which will be arranged by contractor)
- f) Conducting air-tightness test after erection to meet the requirement of BHEL/Customer Standards.
- g) 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.
- h) Fixing of Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring, conduit / GI pipes breather tapping etc after testing.
- i) Fixing of Current transformers and wiring from CT terminal to junction box / Marshalling box, taking through rigid/flexible conduit pipe.
- j) Fixing of Space Heaters and wiring from Space Heaters terminal to junction box, taking through rigid / flexible conduit pipe
- k) Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.
- l) Arranging all T&P material handling equipment required for erection, except those arranged by BHEL.
- m) Calibration of all inspection, measuring and test equipment (IMTEs) before using.
- n) Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.

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- o) Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan (FQP) and getting them signed by BHEL / Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.
- p) Maintaining the equipment after commissioning till taken over by customer
- q) Milli volt drop test is to be carried out for all bolted joints
- r) 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 scope of painting).

1.13.9 SCOPE OF WORK FOR LT SWITCHGEAR 415V - POWER MOTOR CONTROL CENTERS / MCC / DISTRIBUTION BOARDS, ECP AND OTHER CONTROL PANELS:

- 1.13.9.1 LT MCCs are simple module type with isolators and fuses. However, some of the MCCs are Double Front draw out type consisting of circuit breakers unit, contactors/starter fuse switch units, MCB etc. arranged in multi-tier construction.
- 1.13.9.2 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.
- 1.13.9.3 The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If grouting bolts are required for the panel, the same shall be supplied by the contractor at no extra cost.
- 1.13.9.4 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. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis.
- 1.13.9.5 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. The contractor shall carry out fabrication and erection of these support structures. Separate rate shall be paid on Tonnage basis for fabrication and erection of support structures.

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- 1.13.9.6 The MCC's will be located in MCC room at any elevation in the Power house, as per plant layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.
- 1.13.9.7 Panels will be delivered in different shipping sections. The contractor shall set each section of equipment on its foundation or supporting structures and assemble the panels as required. Necessary interconnection of busbar, inter panel wiring, etc. will have to be done by the contractor.
- 1.13.9.8 Generally the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, if necessary, dismantling of the existing Relays / Instruments / Components, making minor modifications in wiring to suit operating conditions, mounting and wiring of new Relays/ instruments / components shall be carried out without any extra cost. Mounting and wiring of any instruments, meters, relays, push buttons, indicating lamps, contactors etc. if supplied loose for safety in transit, shall also be included in the scope of the job. Replacement of defective / damaged components shall be carried out by contractor. The replacement shall be arranged by BHEL if the defect was brought to BHEL's notice immediately after issue of material from BHEL stores. The damages occurring during commissioning/ testing also would be replaced by BHEL. If the defect / damage has occurred during erection, the replacement shall be arranged by contractor. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra cost. The decision of BHEL Engineer shall be final in respect of above extra works.
- 1.13.9.9 The contractor shall do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.
- 1.13.9.10 The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc. with well experienced Engineers / Technicians.
- 1.13.9.11 MCC / PCC incomer bus shall be connected to main source / PCC of customer. The contractor shall co-ordinate for proper connection at both ends.
- 1.13.9.12 Erection of Resistance box of DC drives shall be part of erection of DC starter panels.
- 1.13.9.13 Scope of work shall include drilling of bottom gland plates for cable entry for all the cables to be terminated on the panel, as per requirement.
- 1.13.9.14 Contractor shall co-ordinate with other cable-laying agency for proper cable termination.

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- 1.13.9.15 The contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer as part of panel erection.
- 1.13.9.16 Rubber mats for Switchgear shall be supplied by BHEL, and these shall be laid, wherever required, by the contractor.
- 1.13.9.17 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 indicated in the BOQ.
- 1.13.9.18 The scope of work shall include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels. All T&P, Material handling equipment including cranes and Relay Testing/ HV Testing Calibration equipment/ Instruments shall be arranged by contractor. All testing and calibrating instruments brought by contractor shall be with valid calibration certificates. The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams. Testing shall be done under the supervision of BHEL/Customer Engineers.
- 1.13.9.19 BHEL shall provide vendors' support for commissioning of proprietary type of microprocessor based instruments, protection relays which requires software loading and programmer etc. However overall responsibility lies with contractor and the contractor shall provide all support like manpower, standard T&P, instruments etc. for calibration and commissioning of above proprietary type instruments.
- 1.13.9.20 In certain cases, Switchboards incomer bus shall be connected to bus ducts, through adapter box. The contractor shall co-ordinate for proper busbar connection. If any modification is required in the bus conductor for matching busduct busbar, the same shall be carried out without extra cost.
- 1.13.9.21 The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like servomotors and drives etc. 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 Rate Schedule only once for an equipment). Contractor shall re-commission the equipments once commissioned by him in case a need arises. Contractor will not be paid commissioning charges more than once for same equipment. Commissioning engineers/ supervisors with other technicians, helpers as required will have to come in shifts during commissioning of plant as per BHEL's requirement.

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- 1.13.9.22 All testing Instruments / Equipment deployed to site shall be calibrated before putting the same into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.
- 1.13.9.23 Contractor shall prepare all erection / commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL/ Customer Engineer and submit the same to BHEL Engineer as per his instruction.
- 1.13.9.24 The contractor shall maintain the charged and commissioned equipment till the same is taken over by customer.
- 1.13.9.25 If any removal / Re-fixing of contactors / relays become necessary for the completion of the system, the same shall be done by the contractor at no extra cost.
- 1.13.9.26 Contractor shall put his watch and ward for the equipment under his custody and erected in location against theft and damage by other agencies working on the same area.
- 1.13.9.27 Any loose supplied items like lamps, lens, contactor, fuse/relays/instruments etc. missed from the custody of the contractor shall be replaced by the contractor at no extra cost.
- 1.13.9.28 Dimensions & weights indicated in the BOQ 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 in length within +20% shall not be considered for payment. If the panels have any variation in length beyond +20% as compared to actual length indicated in the BOQ, payment shall be considered proportional to the length of the panel only.
- 1.13.9.29 BHEL shall provide EOT cranes for the purpose of shifting the panels within the PH building as per clause 1.5.1

1.13.10 BATTERY AND BATTERY CHARGER

- 1.13.10.1 The charger and batteries are of heavy duty type, capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden stands. Tentative details are given in the BOM.
- 1.13.10.2 BHEL will provide vendor's technical support for commissioning of Battery and Battery charger / UPS. The contractor shall carry out the works as per instructions of BHEL / Vendor Engineer.
- 1.13.10.3 Lump sum shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The rate quoted for erection of battery will include the following works.

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1.13.10.3.1 SCOPE OF WORK FOR BATTERY

- a) Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items as per drawings.
- b) Filling the individual cells with Acid / Alkali – if applicable.
- c) Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.
- d) Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer / Vendor Engineer.
- e) Modifications or changes if any for the loose supplied items or any minor changes in wiring.
- f) Arranging necessary tools, T&P, Testing equipments required for erection and commissioning of the battery.
- g) For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.

1.13.10.3.2 SCOPE OF WORK FOR BATTERY CHARGER PANELS

The scope of work will be in line with scope of work for electrical control panels, as detailed under Clause 1.13.2

1.13.11 SCOPE OF WORK FOR DIESEL GENERATOR SET

- 1.13.11.1 The DG sets -3 phase, 415 V set with diesel engine, AVR, Radiator, Air Intake System, Exhaust system, Fuel Day Tank, Fuel unloading tank, battery and battery charger sets, Acoustic enclosure, panels, load resistor bank etc.

Cooling system comprising of radiators, engine mounted water pump, self-contained pipe, thermostat etc.

Fuel system consisting of PT fuel pump, injectors, fuel filters, self-contained piping.

Lubricating system consisting of oil pumps, strainers, lube oil cooler, bypass filter, self-contained piping.

Air Intake System consisting of dry type filter, air intake manifold with necessary connectors, turbo charger with after cooler.

Exhaust system consisting of exhaust manifold, flexible piping, residential silencer, exhaust pipe supporting structure, grouting of the structure etc.

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1.13.11.2 SCOPE OF WORK

- a) The scope of works covers erection of Diesel Generator and erection of all loose supplied items, as detailed in BOM.
- b) Minor civil works like drilling, chipping and punching holes and opening in concrete floors, slabs, brick-walls, and cleaning of all debris, Grouting, supply of cement, sand, concrete etc. required for installation of DG sets shall be included in the erection cost of equipment. No separate payment is applicable.
- c) If any minor civil works like modifications/alterations are required for proper installation of Diesel Generator, the same shall be carried out at extra cost. The decision of BHEL Engineer regarding the above will be final.
- d) All T&P, material handling equipments, including crane shall be arranged by the contractor.
- e) All calibration and testing instruments required for relay testing, high voltage testing and load testing shall be arranged by the contractor.
- f) Separate rate shall be applicable for Erection of cable trays, loop cabling between Diesel Generator to Control Panel / MCC and between Control Panel to MCC as indicated in Rate Schedule
- g) Contractor has to commission the DG set under the guidance of DG set supplier's service engineer. Arranging to transport diesel from the nearest petrol / diesel pump to site, filling of diesel, maintaining diesel level in the main and day tank will have to done by the contractor until handing over the set to customer. Diesel will be supplied by BHEL free of cost. The DG set shall be maintained by the contractor after commissioning until full load testing is completed.

1.13.12 SCOPE OF WORK FOR CABLES

BHEL will supply LT cables (1.1 kV, Armoured / Unarmoured, Aluminium / Copper PVC FRLS insulation) of different sizes. (power, control and instrumentation cable). The only instrumentation cables included in the scope of this contract is for VFD System of ID Fans.

- 1.13.12.1 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 cables shall be identified at both ends, adjacent to the cable glands. In addition, cable shall be identified at all drop / pull pits, manholes, pull boxes, and at major changes of direction in cables tray / trenches and multilayer racking cable routes.

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- 1.13.12.2 Unit rates shall be on meter basis. 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.
- 1.13.12.3 Unit rates quoted for cabling shall also include supply of clamping / dressing materials such as Aluminium / GI strips and PVC ties, PVC wire marker sleeves, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. The lugs being used shall be of standard make and shall be procured after getting prior approval of the brand from BHEL engineer. Usage of any other lugs shall entail replacement of the lugs by the contractor at his risk and cost. Supply of above material shall conform to the specification detailed in Volume-IA Part-II Chapter-3. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.
- 1.13.12.4 For single core Power cable, fixing of Trefoil clamps shall be treated as part of laying work.
- 1.13.12.5 If the cables are to be routed on steel angles as per site condition, steel angles will be supplied by BHEL.
- 1.13.12.6 The contractor shall carry out cable dressing and clamping for all the cables laid by him. However, if cables like illumination cables or any other cables of lesser quantity for which no separate trays have been allotted and are to be laid on the same trays, the contractor shall do clamping of such cables also along with the cables laid by him.
- 1.13.12.7 Single core cable used for three phase AC power shall be clamped in tre-foil cable at the time of laying itself.
- 1.13.12.8 The unit rate quoted for cable laying shall also cover the following works.
- a) Enlargement of cable entry holes, if necessary, by chipping/tapping or any modification required fixing of cable glands
 - b) Reaming and relocating holes at actual point of entry of cable or conduit in terminal boxes, outlet boxes, pull boxes etc. cleaning off the debris/trapped material from conduit/ducts.
 - c) In case any existing structure is affected/damaged due to installation work of cables the contractor shall repair the same to the satisfaction of Site Engineer
 - d) However any major modification like drilling, tapping etc. are involved in fixing of glands in JB's and Terminal boxes same shall be considered as extra on man hour rate basis as per extra works clause.

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- e) Minor chipping of concrete floor cutout below panels in order to align the panel's gland plate with the floor cutout shall be done without any extra cost by the contractor.

1.13.12.9 CABLE TERMINATION

- a) The scope of termination shall include termination of cables on various panels / JB's / Push buttons etc. installed by others also. The contractor shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required.
- b) Re-termination if required during testing / commissioning shall be carried out without additional cost.
- c) Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation.
- d) Contractor shall arrange all type of termination and crimping Tools / equipments required for the connections / terminations.
- e) Contractor should use sleeve printers for printing sleeve as wire markers. Cut ferrules will not be permitted to be used. Cross ferruling shall be done for all wire terminations.
- f) After cable terminations, the debris shall be removed then & there
- g) Necessary lugs above 2.5 sq. mm shall be supplied by BHEL free of cost.
- h) Separate rate shall be paid for termination of higher size cables. Such cables will be indicated separately in the BOQ/ Rate Schedule.

1.13.13 SCOPE OF WORK FOR CABLE TRAYS / SUPPORTS / CONDUITS / FLEXIBLE CONDUITS (AS APPLICABLE):

1.13.13.1 CABLE TRAYS

- a) Scope of cable tray works covers erection various sizes of ladder & perforated trays with tray accessories such as bends(vertical and Horizontal), tees, cross, reducers, coupler plates, fasteners etc.
- b) The scope of erection shall also cover erection of all type of trays and its accessories such as coupler plates / fixing plates, anchor bolts, fasteners. Tee, Reducers, Bends (vertical and Horizontal), cross etc,
- c) If accessories such as Tees, Reducers, Bends (vertical and Horizontal), cross not supplied, same shall be fabricated wherever required, from the straight Trays. The accessories supplied may be modified to suit site routing as part of work.

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- d) The scope also covers making offsets by means of cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.
- e) The unit rate for erection of trays shall be on meter basis which includes erection of trays and accessories, fabrication of trays accessories and modification of straight trays, if required.
- f) No separate rate shall be paid for any fabrication of tray accessories or any modification on straight trays.
- g) If trays covers are supplied same shall be erected after completion of cable laying and no separate payment will be made for fixing these covers. GI strip clamps are to be used for fixing the tray covers.
- h) Welded Joints of GI trays shall be painted with cold galvanizing primer/ paint. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.
- i) Cable tray mounting structure shall be welded to the plate inserts or to steel structural beams / members. Welding of cable tray mounting structure to steel structural beams / members shall be done with prior approval of Customer / BHEL Engineer.
- j) Cable tray tag number shall be neatly painted on the cable tray.

1.13.13.2 RIGID & FLEXIBLE CONDUITS

- a) Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe / flexible conduits shall be used as per instruction of BHEL Engineer.
- b) The scope of works for flexible conduit includes drilling of the holes on the plates, fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.

1.13.14 SCOPE OF WORK OF JUNCTION BOXES / MARSHALLING BOX / STARTER BOXES AND PUSH BUTTON BOXES:

Different type of Electrical Junction boxes / Bush button boxes shall be supplied. The scope of installation of Junction boxes / Bush button boxes shall be as follows:

- 1.13.14.1 The unit rate quoted for erection of junction boxes / push button boxes shall include providing necessary supports, drilling of bottom gland plates for cable glands as required, Painting the tag No of JB or fixing a separate tag plate as required on junction boxes / push button boxes, minor chipping, grouting as required for mounting the JBs / PB and supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button. JB number should be painted after completing the work. If the JB has a removable cover, the number shall be painted inside also.

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- 1.13.14.2 Payment for fabrication and fixing of supports shall be on tonnage basis.
- 1.13.14.3 The contractor shall close all unused holes on the gland plates using GROMMET or other suitable material issued by BHEL, within the quoted rate.
- 1.13.14.4 All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.
- 1.13.14.5 If any intermediate JB's are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works. Equivalent Unit rate shall be paid for installation of such JB's. Decision of site engineer will be final regarding the equivalent rate.
- 1.13.15 SCOPE OF WORK FOR FABRICATION & INSTALLATION OF STEEL MATERIALS
 - 1.13.15.1 Scope of steel fabrication and installation covers, fabrication and installation of various types of supports for cable tray, Junction Box / Panel, busducts etc. with angles and channels of different size.
 - 1.13.15.2 The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL.
 - 1.13.15.3 Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.
 - 1.13.15.4 Any minor chipping as required 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.
 - 1.13.15.5 Supply of all cement, sand etc. required for grouting of supports is in the scope of contractor.
 - 1.13.15.6 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.
 - 1.13.15.7 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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1.13.16 SCOPE OF WORK FOR ASH LEVEL INDICATOR:

- 1.13.16.1 Scope of Ash level indicator consists of erection of transmitters (electronic unit), PTFE wires, probes (for high and low level sensing), flexible conduits etc. All PTFE cables shall be routed through GI flexible conduits.
- 1.13.16.2 The unit rate quoted for each set consists of erection of transmitters (electronic units), fixing of probes, laying and termination of PTFE cables through conduits, clamping of flexible conduits etc. The unit rate also covers supply of metallic clamps, lugs etc. Lumpsum rate shall be quoted for each set and no separate payment shall be made against erection of any individual item.
- 1.13.16.3 If any mounting frames are required for insulation of transmitters same shall be carried out on tonnage basis as applicable for other fabrication and erection.

1.13.17 SCOPE OF WORK FOR HEATING ELEMENTS:

- 1.13.17.1 All heating elements shall be fixed by the mechanical contractor.
- 1.13.17.2 Unit rate quoted for heating element includes routing the extension cables through flexible conduits, dressing, terminations and checking of the heating elements.
- 1.13.17.3 Unit rate quoted for thermostat and other standard heating elements covers only checking of elements/thermostat
- 1.13.17.4 ESP HEATING ELEMENTS AND THERMOSTATS
 - a- Checking the healthiness of Elements and Thermostats.
 - b- Setting the value
 - c- Replacement of defective Elements and Thermostats.

1.13.18 SCOPE OF ABOVE GROUND EARTHING

- 1.13.18.1 Earthing scope also covers, earthing of all cable trays, metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, Transformer, Busducts, panels, motors, JB, push button boxes etc as required . All gates of fences shall be connected to earth flat with copper flexible, supplied by BHEL. No separate payment would be made for connecting copper flexible.
- 1.13.18.2 Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carry out rest of the earthing system work.
- 1.13.18.3 Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing material shall be paid on meter basis if appearing in the BOQ.

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1.13.18.4 The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks and splices.

1.13.18.5 Generator neutral from the NGT / NGR cubicle shall be earthed using two dedicated rod electrodes/ treated earth pits, which shall in turn be connected to the main plant grid.

1.13.19 SCOPE OF CIVIL WORKS

1.13.19.1 Only minor civil works like chipping, drilling and punching in concrete floors / slabs / brick walls, grouting of bus duct / Transformer supports in foundation, base frame of panels etc. are covered in the scope of this contract.

1.13.19.2 Scope of civil works includes supply of grouting materials like grouting cement, sand, etc., and cleaning of all debris.

1.13.19.3 More details regarding scope of civil works are given in the respective equipment erection.

1.13.19.4 No separate payment will be applicable for above civil works.

1.13.20 SCOPE OF CALIBRATION

1.13.20.1 Contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, Recorders, Indicators etc. that will be supplied along with equipments mounted in or in loose.

1.13.20.2 All testing Instruments / Equipment deployed for calibration shall be calibrated before taking it into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.

1.13.20.3 All testing instruments shall have calibration certificate issued by recognized / accredited agencies.

1.13.20.4 If BHEL is unable provide or arrange vendor support for proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by out side agency shall be reimbursed by BHEL. However if above such calibrator is available with BHEL at site the calibration shall be carried out by the contractor within the quoted rates.

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

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1.13.21 SCOPE OF WORK FOR HEAT TRACING SYSTEM:

- 1.13.21.1 Heat tracing systems shall have heat tracing control panels and electrical heat tracer tape. Heat Tracer Tape will be supplied with all the accessories like power connector, tee connector, splice connector, end connector, adhesive tapes, pipe straps, thermostats etc
- 1.13.21.2 Separate heat tracing panels shall be supplied with transformer and other protection.
- 1.13.21.3 Unit rate quoted for Heat Tracer Tape shall cover laying and termination of tape and installation of all the above said accessories. No separate unit rate shall be applicable for installation of accessories. All other terms and condition shall be in line with scope of cable laying.
- 1.13.21.4 Unit rate quoted for Erection and commissioning Heat tracer panels shall be in line with Control Panels.

1.13.22 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

1.13.22.1 All types of LT drives

- a- Cable identification, checking and measuring insulation resistance (IR).
- b- IR value of motor, measurement of winding resistance etc.
- c- Dryout all the motors if required to improve IR value.
- d- Limit switch and torque switch setting
- e- Calibration of Electronic cards, modules etc. and fixing the same if supplied as loose item.
- f- Checking direction of rotation of motors and testing and commissioning from local as well as remote.
- g- Attending to any defects till the handing over of the unit to customer.
- h- Replacing defective components like limit switches, electronic cards etc.

1.13.22.2 Skid mounted Panels.

- a) The skid mounted panels will be erected by mechanical contractor. The scope of commissioning of Panels covers checking of internal wiring and associated loop cables from panels to field instruments, Push Buttons, JB's, drives, replacing defective components / Instruments / electronic cards etc.
- b) If any loop cables (power or control) are to be laid or replaced, the same shall be carried out at unit rates available in the BOQ.
- c) For commissioning of associated drives, if any, the unit rate will be as per BOQ and this will not be part of panel commissioning.

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1.13.22.3 Hoist:

All internal cabling will be carried out by the hoist suppliers. However the scope of works of hoist covers besides works mentioned for LT drives, the checking of control panels wiring, field wiring like push button, motors, limit switch etc., fixing of Trailing cables, and making ready for load test by mechanical agency.

1.13.22.4 ESP Heating Elements and Thermostats

- a- Checking the healthiness of Elements and Thermostats.
- b- Setting the value
- c- Replacement of defective Elements and Thermostats.

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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 / ferules / lugs) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.
- 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

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- d) Category- wise man hours engaged during the previous month under the categories like fitters, electricians, welders, riggers, khalasis, grinder-men, 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 etc 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

TESTING, PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

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

- 1.15.1 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 EDTA.
 - d) Turbine barring gear.
 - e) Steam blowing of piping.
 - f) Turbine rolling.
 - g) Safety valve floating.
 - h) First synchronization
 - i) Trial Operation / Full load.
- 1.15.2 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.
- 1.15.3 The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.
- 1.15.4 The pre-commissioning activities of the main power plant shall 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 BHEL hands over the Unit to their Customer. 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 specialized 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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- 1.15.5 The mobilization of testing team shall be planned in time and shall be undertaken round the clock. The 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 shall be recovered from contractor.
- 1.15.6 Prior to commissioning and after commissioning, protocols have to be made with BHEL / customer. The formats shall 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
- 1.15.7 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, if 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.
- 1.15.8 Minimum requirement of Man Power for testing / checking works shall be as follows (Requirement given below is per unit):

	SWITCHGEAR / PANELS	BUS DUCT	CABLING
Engineer	2		2
Supervisor	4	1	2
Technician	6	1	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

- 1.15.9 T&P / instruments required for testing are to be arranged by the contractor

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1.15.10 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 shall be witnessed by BHEL engineer and the reports signed jointly.

1.15.11 The scope of commissioning assistance to be provided by the contractor shall cover the equipment/drives erected by the mechanical contractors as detailed in the BOQ.

1.15.12 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

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 BOQ.

All types of Drives and Generator

- a- Cable identification, checking and meggering.
- b- IR value of 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

1.15.13 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.

1.15.14 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.

1.15.15 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.

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- 1.15.16 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.
- 1.15.17 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.
- 1.15.18 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.
- 1.15.19 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.
- 1.15.20 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.
- 1.15.21 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.
- 1.15.22 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.

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- 1.15.23 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.
- 1.15.24 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.

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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 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 as specified by BHEL 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 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, danger / warning signs and other data as required by BHEL within the quoted rate.

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- 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.
- 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.

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- 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 etc. as per the scope of erection.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.

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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.
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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.

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

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.

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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.
- 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.

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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.
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.

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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 overtight the bolts.
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

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- 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.

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.

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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.

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.

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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.

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 breading 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.

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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.

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

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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.

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.

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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.

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.

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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.

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. Lightening 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.

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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	

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

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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.

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.

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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.

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.

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- 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.
- 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 for 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 excess 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.

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- 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, Pilol 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.
- 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.

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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 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.

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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

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						

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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

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

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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.

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.

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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 modules 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 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

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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 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.

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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.
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.

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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
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.

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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.
- 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.

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- 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.
- 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).

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- 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)
 - 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)

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- 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.
- 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.

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- 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

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2. Dielectric test
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

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10. Measurement of no load current for all phases
11. Measurement of temperature of body during no load and load conditions.
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.

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

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

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.

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- 2.2.12.3 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.
- 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 / JBs

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. PVC wire marker sleeves and Tag plates

2.3.1.10 GI / aluminum flats for cable dressing

2.3.1.11 PVC cable ties

2.3.1.12 Welding electrodes, gases etc.

2.3.2 Wastage Allowance:

Support installation : 1% by weight