

TENDER SPECIFICATION

BHEL: PSSR: SCT: 1456

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work, Erection, Testing and Commissioning of **Controls and Instrumentation Package** including Supply & Applications of touch-up, preservation and final painting for Unit- 1&2, 2x600 MW, Stage-II

at

North Chennai Thermal Power Station,
Atthipattu,
Chennai – 120, Tamil Nadu.

VOLUME –I BOOK - I

TECHNOCOMMERCIAL BID (Book I & II)

Book-I consists of

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

Book-II consists of

- Volume-IB : Special conditions of Contract,
- Volume-IC : General conditions of Contract
- 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: 1456

for

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning, Supply & Applications of touch-up, preservation and final painting of **Controls & Instrumentation Package** of 2 X 600 MW Stage II Unit- 1&2 at **North Chennai** Thermal Power Station, Atthipattu, Chennai – 120, Tamil Nadu.

One set of Tender documents consisting of

- 1) TECHNOCOMMERCIAL BID - 2 copies
- 2) RATE SCHEDULE - 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 1456	
ii	Broad Scope of job	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning, Supply & Applications of touch-up, preservation and final painting of Controls & Instrumentation Package of 2 X 600 MW Stage II Unit- 1&2 at North Chennai Thermal Power Station, Atthipattu, Chennai – 120, Tamil Nadu	
iii	DETAILS OF TENDER DOCUMENT		
a	Volume-IA	<i>Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc</i>	<i>Applicable</i>
b	Volume-IB	<i>Special Conditions of Contract (SCC)</i>	<i>Applicable</i>
c	Volume-IC	<i>General Conditions of Contract (GCC)</i>	<i>Applicable</i>
d	Volume-ID	<i>Forms and Procedures</i>	<i>Applicable</i>
e	Volume-II	<i>Price Schedule (Absolute value).</i>	<i>Applicable</i>
iv	Issue of Tender Documents	1. <u>Sale from BHEL PSSR Regional office at :Chennai</u> Start : Apr 21, 2011	<i>Applicable</i>

		<p>Closes: May 10, 2011 , Time :15.00 Hrs</p> <p>2. From BHEL website (www.bhel.com) Tender documents can however be downloaded from website till due date of submission</p>	
v	DUE DATE & TIME OF OFFER SUBMISSION	<p>Date : May 11, 2011, Time :15.00Hrs Place : <u>BHEL PSSR :Chennai</u> Tenders can be submitted through representative / in person at SCT Dept, BHEL PSSR, Chennai.</p>	Applicable
vi	OPENING OF TENDER	<p>Date : May 11, 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</p>	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	<p>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</p>	Applicable
x	SCHEDULE OF Pre Bid Discussion (PBD)	Date: May 04, 2011. Time 11.00AM 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	

	only (www.bhel.com → Tender Notifications → View Corrigendum) and not in the newspapers . Bidders to keep themselves updated with all such information. This also form part of tender hence the same shall be enclosed with their offer.	
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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)	

	<p>TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION:</p> <p>CONTAINING THE FOLLOWING:-</p>	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	<p>Duly filled-in 'No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above.</p> <p>Note:</p> <p>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.</p> <p>b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding.</p> <p>(i) In case of acceptance of the deviations, appropriate loading shall be done by BHEL</p> <p>(ii) In case of unacceptable deviations, BHEL reserves the right to reject the tender.</p>	
iii.	<p>Supporting documents / annexure / schedules / drawing etc as required in line with Pre-Qualification criteria.</p> <p>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.</p>	
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	If applicable
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification / NIT	
vii.	Notice inviting Tender (NIT)	
viii.	Volume – I A : <u>Technical</u> Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	
ix.	Volume – I B : Special Conditions of Contract (SCC)	
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	
xiii.	Any other details preferred by bidder with proper indexing.	

PART-I B	
	<p><u>ENVELOPE – II superscribed as:</u> PART-I (EMD/COST of TENDER) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION:</p> <p>CONTAINING THE FOLLOWING:-</p>
i.	<p>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</p> <p>2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)</p>

PART-II	
	PRICE BID consisting of the following shall be enclosed
	<p><u>ENVELOPE-III</u> superscribed as: PART-II (PRICE BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION:</p> <p>CONTAINING THE FOLLOWING</p>
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	
	<p><u>ENVELOPE-IV</u> (MAIN ENVELOPE / OUTER ENVELOPE) superscribed as: TECHNO-COMMERCIAL BID, PRICE BID & EMD TENDER NO: NAME OF WORK: PROJECT: DUE DATE OF SUBMISSION:</p> <p>CONTAINING THE FOLLOWING:</p>

i	<ul style="list-style-type: none"> ○ Envelopes I ○ Envelopes II ○ Envelopes III 	
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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 July 2011)**

Bidders capacity for executing the job under tender shall be assessed as per the following:

I. **Assigning Weightages (A) for Similar Jobs Under-Execution:**

Weightages shall be worked out and assigned based on the average number of Similar Works under execution including works yet to be commenced by the agency, in the following manner:

i). **Number of Similar Jobs**

- a) No. of jobs in BHEL, PSER : Say 'J'
- b) No. of jobs in BHEL, PSSR : Say 'K'
- c) No. of jobs in BHEL, PSWR : Say 'L'
- d) No. of jobs in BHEL, PSNR : Say 'M'
- e) No. of jobs with other customers* : Say 'N' (*: Other than BHEL
PSER, PSSR, PSWR & PSNR)

f) Average No. of Jobs is 'P' = (J+K+L+M+N) divided by 5

ii) Weightage "A" assigned to bidders based on Average Number of jobs "P":

- a) If 'P' = 0-1, "A" will be equal to '3'
- b) If 'P' = 2-3, "A" will be equal to '2'
- c) If 'P' = 4-5, "A" will be equal to '1'
- d) If 'P' is Above 5, "A" will be equal to '0'

II. **Weightage "B" for Quarterly Performance Reports of Vendors:** This shall be based on the averages of the net weighted score obtained by the bidder for the jobs under execution (excluding works not commenced) for the quarter previous to the last quarter reckoned from the date of latest due date of

submission, in all four Regions i.e BHEL PSER, PSSR, PSWR & PSNR, in the following manner.

i). Ratings by Power Sector Region:

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

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

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

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

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

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

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

IV. Explanatory note:

- a) Similar work means Boiler or Turbine or Civil or Electrical or CI, etc as detailed in the scope irrespective of rating of Plant.
- b) Quarter shall be as per the quarter defined in the "Evaluation of Contractor performance (Quarterly)". For contracts where annexed Quarterly Evaluation performance was not part of the contract, 'Quarterly Performance Reports' previous to the last quarter reckoned from the date of latest due date of submission, given by the respective project site against the contract will be the basis for evaluation.
- c) Vendors who are not executing any jobs presently in the Region and first timers to the Region, may be considered subject to satisfying all other tender conditions

- d) 'Under execution' shall mean works in progress upto Boiler Steam Blowing (for Boiler and Auxilliaries) or Synchronisation (for all other jobs including Civil) shall be considered.
- 10.0 Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation etc before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above.
- 11.0 For any clarification on the tender document, the bidder may seek the same in writing or through e-mail, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.
- 12.0 BHEL may decide holding pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.
- 13.0 In the event of any conflict between requirement of any clause of this specification / documents / drawings / data sheets etc or requirements of different codes / standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages / other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting / submission of offer, else BHEL's interpretation shall prevail.
- 14.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender including PBD.
- 15.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), **if applicable**, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. **The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (xi) of 1 above.**
- 16.0 The Bidder has to satisfy the Pre Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of pre-qualification

evaluation/ techno-commercial bids, approval/ acceptance of customer (as applicable), etc. and date of opening of price bids shall be intimated to only such bidders.

17.0 In case BHEL decides on a 'Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorised representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful/Disqualified bidders under intimation to the respective bidders.

18.0 Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) or specified otherwise in SCC of tender.

19.0 BHEL reserves the right to decide the successful bidder on the basis of Reverse Auction process. In such case all qualified bidders will be intimated regarding procedure/ modality for Reverse Auction process prior to Reverse Auction and price will be decided as per the rules for Reverse Auction. .

However, if reverse auction process is unsuccessful as defined in the RA rules/procedures, or for whatsoever reason, then the sealed 'PRICE BIDS' will be opened for deciding the successful bidder. BHEL's decision in this regard will be final and binding on bidder.

20.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.

21.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.

22.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.

23.0 In case Consortium Bidding is allowed as per Pre Qualifying Requirement, then Prime Bidder and Consortium Partner shall enter into Consortium Agreement. Validity period of Consortium Agreement shall be 6 months after which the same can be re validated.

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

24.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements" duly self certified and stamped by the authorized signatory,

indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

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

26.0 Mode of Award of work for unit-1&2

26.1 There are two units of 600 MW each at North Chennai Thermal Power Project. Tender SCT1456 is for Unit 1 – 600 MW only. The quantity indicated in the price bid is for Unit 1 only and the quantity for Unit 2 is also same.

26.2 The L1 bidder against this quote will be awarded the contract for one unit of North Chennai Thermal power project.

26.3 BHEL reserves the right to award the contract for other Unit of North Chennai Thermal Power Project on the same terms and conditions of SCT 1456 to the next lowest bidder in the order of competitiveness who should match his rates / price with awarded price / rate for awarded Unit.

26.4 Thus the work for Units 1 and 2 will be awarded to two agencies i.e. Unit 1 work for one agency and Unit 2 work for the other agency. However, of the two units, which unit to be awarded to which agency is subject to BHEL's discretion.

26.5 In case the other bidders in their order of competitiveness do not accept to match their rates/Price with awarded price / rate of first awarded Unit, then BHEL reserves the option to consider the L1 bidder, for award of next Unit work also at the same rate/Price and at the same Terms & Conditions of first awarded Unit. This will be solely at the discretion of BHEL and the L1 bidder, who is awarded the work of one Unit, shall not have any claim for award of other Unit work to him, on conditions whatsoever.

26.6 In case BHEL, at its discretion opts to go for re-tendering for award of work for second Unit, then the L1 bidder who is awarded with first Unit work shall not be considered for second unit work.

26.7 Each unit will be treated as a separate contract.

27.0 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, Supply & Applications of touch-up, preservation and final painting of Controls & Instrumentation Package of 2 X 600 MW Stage II, Unit- 1&2 at North Chennai Thermal Power Station, Atthipattu, Chennai – 120, Tamil Nadu
TENDER NO	BHEL PSSR SCT 1456

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)	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 July 2011</u>	
C	<u>Technical</u> The bidder should have completed Erection, testing and commissioning of DCS/PLC based Power Plant Instrumentation System including field Instrumentation works such as Impulse pipes, Pneumatic Actuators, cabling, trays etc in Boiler or Turbine or Station C&I controls of unit rating not less than 190 MW rating in a Thermal/gas Power Plant in the last seven years. First synchronization of the unit will be considered as completion of C&I works.		
D 1	<u>Financial</u> TURNOVER Bidders must have achieved an average annual financial turnover (audited) of Rs 49 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 Work order / LOI / LOA and work completion certificate) IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

ANNEXURE - 2

CHECK LIST

NOTE: - Tenderers are required to either fill in or submit separately the following details.

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)

CONTENTS

SI no	DESCRIPTION	Chapter	No. of Pages
Vol IA	Part-I: Contract specific details		
1	Project Information	Chapter-I	01
2	Scope of works	Chapter-II	02
3	Consumables & Facilities in the scope of Contractor / BHEL (Scope Matrix)	Chapter-III	07
4	T&Ps and MMEs to be deployed by Contractor	Chapter-IV	08
5	T&Ps and MMEs to be deployed by BHEL on sharing basis	Chapter-V	01
6	Time Schedule	Chapter-VI	02
7	Terms of Payment	Chapter-VII	03
8	Taxes and other Duties	Chapter-VIII	02
9	BOQ/Weight schedule	Chapter-IX	35
10	General	Chapter-X	07
11	Foundation & Grouting	Chapter-XI	02
12	Handling & storage	Chapter-XII	02
13	Scope of works-Detailed	Chapter-XIII	18
14	Progress of work	Chapter-XIV	02
15	Testing & Commissioning	Chapter-XV	07
16	Painting	Chapter-XVI	02
Vol IA	Part-II: Technical specifications		
1	Reverse auction procedure	Chapter-1	02
2	Technical Requirements and Guidelines for Installation, Testing, Commissioning and Supply items of C&I package	Chapter-2	30
3	Data sheet	Chapter-3	3

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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. 45^o C(Highest mean monthly Max.35^o C)
: Absolute Min. 15^o C (Lowest mean monthly Min. 24^o C)
: Average 35^o 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.
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:

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

1.2.1 The Scope of work covered in the C&I packages shall be as follows:

- 1.2.1.1 Erection and commissioning of All Types of Field Instruments like Temperature, Pressure and Flow instruments (local & remote) and special instruments like EWLI, Sonic Tube Leak Detection system, Vibration Monitoring System, SWAS, Gas analyser, Coal Flow Monitor, Master clock system, Coal Bunker level monitor, CCTV System, LVS System, Hart Management System, Furnace Flame Viewing system etc.
- 1.2.1.2 Erection and commissioning of all types of Control room mounted instruments like Recorders, Indicators, Microprocessor based panels, DCS system and its accessories like system panels, PC, printers, furniture etc.
- 1.2.1.3 Erection and commissioning of all Types of Pneumatic Power Cylinders, Controllers etc.
- 1.2.1.4 Commissioning of all Types of Pneumatic operated Valves / Actuators / Power Cylinders / Controllers and Relief Valves.
- 1.2.1.5 Erection of all types of Hardware like impulse pipes, trays & tray supports, instrument air line, etc.
- 1.2.1.6 Erection & Testing of all types of power/control/instrumentation cables etc.
- 1.2.1.7 Erection and commissioning of UPS, ACDB, Battery, Battery Charger, DCDB etc.
- 1.2.1.8 Erection and commissioning of control panels.
- 1.2.1.9 Fabrication and installation of steel supports wherever required.
- 1.2.1.10 Supply of all consumables required for installation as detailed elsewhere in the contract.
- 1.2.1.11 Installation of any other items that have not been specifically indicated, but required for completing installation.

Note: BHEL will provide vendor's technical support for commissioning of various proprietary type special instruments/ systems like Analysers, Vibration Monitoring System, Battery/ Battery Charger, Coal Flow Monitor, Master clock system, Coal Bunker level monitor, Sonic Tube Detection System, Hart Management System etc. The contractor shall carry out the works as per instructions of BHEL/ Vendor Engineer.

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1.2.2 GENERAL

1.2.2.1 Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.

1.2.2.2 Supply of paints and consumables

1.2.2.3 Final painting including supply of paints.

1.2.3 EXCLUSIONS

The following are specific exclusions from this work

- a. Erection of dampers, valves, electrical actuators, HT/LT drives
- b. Attachment welding of thermocouple pads, flow nozzle, orifice plates and control valves
- c. Root valves on the instruments tapping points

NOTE:

The above exclusions should not be concluded as final. They are meant for general guidelines. BHEL reserves the right to include or exclude any item which is required for completing the job as per rates indicated in rate schedule. Contractor should carry out all such jobs as per the instructions of BHEL, Engineer.

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)

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.1	PART I 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.

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

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- 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 supplying and 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.
- 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,

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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 AT HIS COST FOR ERECTION AND COMMISSIONING OF RESPECTIVE EQUIPMENT/ ITEMS**

1.3.6.1 All welding electrodes, Gases and other consumables shall be arranged by the contractor at his cost.

1.3.6.2 Supply of paints, Ferrules, lugs (for sizes upto 2.5 sq mm) shall be in the scope of the contractor within the quoted rate.

1.3.6.3 Other items

- 1 Provision for Temporary Scaffoldings.
- 2 "U" Clamps with nuts and washers for impulse pipes and GI pipe clamping.
- 3 Tag Plates- Al/ Fiberglass/ Stainless Steel
- 4 Insulation tape.
- 5 Teflon tape for GI pipe coupling.
- 6 Paints required for primer coating and final coating paint of approved colour, Consumables like thinner, brushes, emery paper etc.
- 7 Solder wire (Lead) -(60/40)
- 8 Protocol/Calibration report sheets as per BHEL Format.
- 9 Fastener for mounting JB and local PB Boxes.
- 10 Panel/ JB Sealing compound material (for cable entry from bottom/Top of Panel).
- 11 PVC cable tie, Aluminium or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing, grommet
- 12 sleeves for cables

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13 Solderless crimping type

14 Anchor fasteners for fixing panels & JB's

1.3.6.4 TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

1 CABLE LUGS:

a) Type: Solderless crimping type

b) Material Copper / Aluminium

c) Whether tinning required Yes.
(For copper cable lugs)

d) Thickness of tinning: 10 microns

e) Applicable Standard for IS:8309
LT Cables

2 FERRULES:

a) Colour of ferrules: Yellow/White

b) Colour of engraving Black

3. TAGS:

a) Material : Al/Fiberglass/ Stainless Steel

b) Markings: Engraving/Embossing/Printing

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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 minimum Instruments / T&P shall be arranged by contractor in sufficient number to carry out the job simultaneously in more than one area.
- 1.4.3 RECOMMENDED LIST OF TOOLS AND TACKLES / INSTRUMENTS TO BE ARRANGED BY CONTRACTOR AT HIS COST.

SL NO	DESCRIPTION	QUANTITY
01	Dead Weight tester rated 600 Kg/Sq.cm with weights & test gauges facility	02 No.
02	Oil temperature bath suitable to calibrate upto 300 Deg C	02 No.
03	Dry type temperature calibrator (range 600 Deg C)	01 No.
04	Standard Pressure Gauges as below :	
	0 to 1 Kg/Sq.cm	01 No.
	0 to 5/6 Kg/Sq.cm	01 No.
	0 to 10 Kg/Sq.cm	01 No.
	0 to 16 Kg/Sq.cm	01 No.
	0 to 25 Kg/Sq.cm	01 No.
	0 to 60 Kg/Sq.cm	01 No.
	0 to 100 Kg/Sq.cm	01 No.

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05	0 to 250 Kg/Sq.cm Standard Temperature Gauges as below : 0 to 100 Deg C 0 to 200 Deg C 0 to 600 Deg C	01 No. 02 No. 02 No. 02 No.
06	Standard compound pressure gauge -1 to +3 kg/Sq.cm	02 No.
07	Standard Vacuum Gauge -760 mm Hg to 0 Kg/Sq.cm	01 No.
08	Manometer 0 to 1000 mm WC with hand bulb	03 Nos.

SL NO	DESCRIPTION	QUANTITY
09	Portable air compressor with drier and regulator rated for 10 Kg/Sq.cm	01 No.
10	Vacuum pump with standard vacuum gauge	01 No.
11	Standard Milliamps Source (Digital)	03 Nos.
12	Standard Millivolts Source (Digital)	03 Nos.
13	Mercury Manometer different range	04 Nos.
14	DC Power Supply , 24 V ; 5A	03 Nos.
15	Single Phase Variac 250V; 10A	01 Nos.
16	Glass Thermometers of ranges in Deg C as below : 0-120 ; 0-200; 0-600	02 Nos. (Each)
17	Tong tester AC 5/10/25 ; KEW Snap Make	01 No. (Each)

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18	Function Generator	01 No.
19	Hand Operated Megger 500V ; 2.5 KV / 100 M Ohms	Each type As required
20	Torque wrench	As required
21	AC Voltmeter 0-125 ; 250 ; 625V	01 No. (Each)
22	AC Ammeter 0-2A ; 10A	1 No. (Each)
23	Analog Multimeter Motwane Make	03 Nos.
24	Digital Multimeter 3 1/2 Digit	08 Nos.
25	Digital Multimeter 4 1/2 Digit	03 Nos.
26	Wire wrapping tool	As required
27	Oscilloscope	01 Nos.
28	Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.	As required

1.4.4 RECOMMENDED LIST OF HANDLING INSTRUMENT AND MAJOR TOOLS & PLANTS TO BE ARRANGED BY CONTRACTOR

S.NO	DESCRIPTION	QUANTITY
01	Steel wire ropes	As required
02	Chain pulley block/turfer	As required
03	2 " size pipe bending machine	As required
04	Grinding machine	As required
05	Drilling machines : 1/4" , 1/2" , 3/4" , 1 "	As required
06	Copper tube bender and cutter sizes 6 mm ;8 mm ;1/2",1/4"	As required
07	Dye sets for threading upto 2 " pipe	As required
08	Set of spanners	As required

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09	Allenkey sets	As required
10	Bench vice	1 No.
11.	Spirit level	As required
12	Tap sets for both BSP & NPT threads upto 1 "	1 Set each
13	Measuring instruments like micrometers, calipers etc.	1 each
14	Welding generator	1 No.
15	Welding transformer	As required
16	TIG Welding set	1 No.
17	Mechanical tool kit for fitters	As required
18	Electrician tool kit	As required
19	Crimping tool	As required
20	Flood light fittings	As required
21	Fire extinguishers	As required
22	Distribution boards with power cable complete as required	As required
23	Hydraulic test pump rating 750 Kg/SQ.cm	As required
24	Painting brush	As required
25	Fire proof tarpaulin	As required
26	Safety belts & safety helmets	As required
27	Telephone sets	As required
28	Walkie Talkie Sets	As required

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1.4.5 ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

SI. No	INSTRUMENT / TOOL	RANGE	ACCURACY
01	Digital Multimeter	Voltage 200 mV to 1000 V DC	$\pm 1\% + 1$ digit
		Philips Voltage 200mV to 1000 V AC	$\pm 1\% + 1$ digit
		Hcl Current 200 mA to 10 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 20M*	$\pm 0.5\% + 1$ digit
		Resistance (Hcl) 2105 200* to 200M*	$\pm 0.25\% + 3$ digits
		Hcl Voltage 200 mV to 750 V	$\pm 0.8\% + 1$ digit
		Philips Current 20 mA to 20 A DC	$\pm 0.5\% +$ digit
		Hcl Current 200 mA to 010 A AC	$\pm 1\% +$ digit
		02	Analog Multimeter
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	$\pm 1\%$		
03	MV/mV Source	0 to 200 mA/200mV	0.2%
		0 to 700	$\pm 1\%$ Lc – 10 kg/cm ² 10"
		0 to 700	$\pm 1\%$ Lc – 5 kg/cm ² 10"
		0 to 100	$\pm 1\%$ Lc – 0.2 kg/cm ² 10"
		0 to 70 kg	$\pm 1\%$ Lc – 1 kg/cm ² 10"
		0 to 60 kg	$\pm 1\%$ Lc – 11 kg/cm ² 10"
		0 to 60 kg	$\pm 1\%$ Lc – 0.5 kg/cm ² 10"
		0 to 10.5 kg/cm ²	$\pm 1\%$ Lc – 0.25 kg/cm ² 10"
		0 to 420	$\pm 1\%$ Lc – 2.5 kg/cm ² 10"
		0 to 280	$\pm 1\%$ Lc – 2.5 kg/cm ² 10"

Dial size

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SI. No	INSTRUMENT / TOOL	RANGE	ACCURACY
04	Hand operated Megger 500V/1000V	0 to 40	$\pm 1\%$ Lc – 1 kg/cm ² 10"
		0 to 106	$\pm 1\%$ Lc – 2.5 kg/cm ² 10"
		0 to 28	$\pm 1\%$ Lc – 0.5 kg/cm ² 10"
		0 to 25 kg/cm ²	$\pm 1\%$ Lc – 0.5 kg/cm ² 10"
		0 to 250 kg/cm ²	$\pm 1\%$ Lc – 0.25 kg/cm ² 10"
		0 to 16 kg/cm ²	$\pm 1\%$ Lc – 0.25 kg/cm ² 10"
05	Standard Pressure Gauges	Upto 200 m Ohms	$\pm 5\%$ at Centre scale
0 to 1 kg/Cm ²		$\pm 0.25\%$ Lc–0.02 kg/cm ² 10"	
0 to 10 kg/Cm ²		$\pm 0.25\%$ Lc–0.02 kg/cm ² 10"	
0 to 25 kg/Cm ²		$\pm 0.25\%$ Lc–0.25 kg/cm ² 10"	
0 to 60 kg/Cm ²		$\pm 0.25\%$ Lc–0.1 kg/cm ² 10"	
0 to 250 kg/Cm ²		$\pm 0.25\%$ Lc–2.5 kg/cm ² 10"	
0 to 400 kg/Cm ²		$\pm 0.25\%$ Lc–2.5 kg/cm ² 10"	
0 to 600 kg/Cm ²		$\pm 0.25\%$ Lc–2.5 kg/cm ² 10"	
0 to 6 kg/Cm ²		$\pm 0.25\%$ Lc–0.1 kg/cm ² 10"	
0 to 1000 kg/Cm ²		$\pm 0.25\%$ Lc–1.0 kg/cm ² 10"	
06	Dead Weight Tester	0 to 400	Lc – 5 kg/cm ²
		0 to 600	Lc – 5 kg/cm ²
07	Standard Hg in glass Thermometer	0 to 100°C	Lc - 1°C
		0 to 110°C	Lc - 1°C
		0 to 250°C	Lc - 1°C
		0 to 150°C	Lc - 1°C
		0 to 360°C	Lc - 1°C
		0 to 420°C	Lc - 1°C
08	Single Phase Variac	15A Capacity	N/A

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Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
09	Power Pack	0 to 50V DC, 3A	$\pm 2\%$
10	Vibration Measuring Equipments	Velocity upto 50 mm/sec. Displacement upto 300 microns	$\pm 0.5\%$ mm/sec ± 2 microns
11	a) Tongue tester	0/300/600A AC	$\pm 5\%$
	b) Tongue tester	0 to 300A DC	$\pm 5\%$
12	Tacho Meter (Hand held)	0 to 4000 rpm	$\pm 5\%$
13	Phase Sequence Meter		N/A
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	$\pm 5\%$ at Centre Scale range
15	DC Ammeter	0 to 300 A	$\pm 10\%$
16	DC Voltmeter	0 to 500 V	$\pm 10\%$

1.4.6 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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- k. All testing instruments shall have calibration certificate issued by recognized/accredited agencies.
- l. Contractor shall maintain calibration records as per the format CP: PEX:FOX enclosed in the Tender Specification and produce them whenever called for by BHEL Engineers.
- m. Above deployment plan will be discussed with the site engineer and necessary changes will have to be made by the contractor as per discussions. If required, an additional deployment during execution of work will have to be made by the contractor for meeting various schedules/targets set by BHEL without any additional compensation.

1.4.7 PROTECTION / HANDLING OF TOOLS AND PLANT ARRANGED BY THE CONTRACTOR

- 1.4.7.1 Equipment, vehicles, tools and plants and materials brought to site by the contractor from his resources shall have distinctive identification marks and the contractor shall intimate the description and quantity to BHEL in writing.
- 1.4.7.2 All construction materials brought by the contractor shall have prior approval regarding quality and quantity by BHEL. The contractor shall also provide without extra cost necessary enclosures containers and protective materials for proper storage of materials inside, whenever so instructed by the purchaser without any extra cost.
- 1.4.7.3 No material or equipment or tools etc. shall be taken out of the work-site without the written consent of BHEL.
- 1.4.7.4 BHEL shall not be responsible for the safety and protection of the materials of the contractor and the contractor shall make his arrangements for proper watch and ward for his materials.
- 1.4.7.5 Until such time the work is taken over by BHEL, the contractor shall be responsible for proper protection including proper fencing, guarding, lighting, flagging, watching. The contractor shall during the progress of work properly cover up and protect any part of the work liable to damage by exposure to the weather and shall take every reasonable precaution against accident or damage to the work from any cause.

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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 crane 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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 **14 (fourteen) 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 (June-2011)	1 st month (July-2011)
Boiler Light Up	3 rd month	3 rd month
Barring gear	7 th month	7 th month
Synchronisation	8 th month	8 th month
Full load / Trial Operation	11 th month	11 th month
Handing over	14 th month	14 th month

- 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

& augment all necessary resources from time to time on the instructions of BHEL.

1.6.5 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be **14 (fourteen) months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work per unit and unit-2 shall be started with a phase shift of one month from start of unit-1.

1.6.6 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 1.7.1.10.1 of the following table.

TERMS OF PAYMENT FOR C&I WORKS		
Sl. No.	Activity / Work Description	% of unit rate
1.7.1.	PRO RATA PAYMENTS (85%)	
1.7.1.1	For all type of Instruments including Power Cylinder /Actuator	
1.7.1.1.1	Receipt, transport to erection site, assembly, checking, calibration, fixing and clamping Adjustment, Alignment, on pro rata basis and protocol signed	60%
1.7.1.1.2	Pre-commissioning tests, checks, and making ready for energisation pro rata basis and protocol signed	15%
1.7.1.1.3	Completion of commissioning	10%
	Total =	85%
1.7.1.2	Cable laying and cable termination	
1.7.1.2.1	Laying/tagging/termination of cables / Wires	65%
1.7.1.2.2	Checking ,dressing and clamping	10%
1.7.1.2.3	Loop checking and commissioning	10%
	Total =	85%
1.7.1.3	AC&DCDB/DCS/MMI/PLC system and all types of control panels including MMIPIIS(DCS) Related Instrumentation	
1.7.1.3.1	Receipt transport to erection site ,placement, assembly, fixing and clamping adjustment, alignment, grouting and electrical interconnections on prorata basis and protocol signed	65%
1.7.1.3.2	Pre-commissioning tests, checks and making ready for energisation on prorata basis and protocol signed	10%
1.7.1.3.3	Completion of Commissioning	10%
	Total =	85%
1.7.1.4	For fabrication and installation of steel materials including LIR/LIE	

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1.7.1.4.1	Fabrication / Pre assembly and applying primer paint	45%
1.7.1.4.2	Erection, Alignment, welding/ bolting and if applicable chipping / grouting / painting	40%
	Total =	85%
1.7.1.5	For UPS/Battery sets/charger	
1.7.1.5.1	Receipt, transport to erection site, checking, placement, assembly, grouting, mounting and wiring of loose components	50%
1.7.1.5.2	Adjustment, alignment, inter connections and pouring of Alkali	20%
1.7.1.5.3	Precommissioning test checks and making ready for energisation	15%
	Total =	85%
1.7.1.6	For cable trays, tray supports, Rigid and flexible conduits & copper tubes, earthing	
1.7.1.6.1	On satisfactory completion of work on prorata basis	70%
1.7.1.6.2	On completion of drawing or area wise on prorata basis	15%
	Total =	85%
1.7.1.7	For Impulse Pipes	
1.7.1.7.1	On laying and welding on prorata basis and protocol signed	50%
1.7.1.7.2	On clamping and painting on prorata basis and protocol signed	20%
1.7.1.7.3	System Charging	15%
	Total =	85%
1.7.1.8	Testing / Commissioning of Equipment erected by other agencies	
1.7.1.8.1	On completion of commissioning of individual racks/skid/actuators/ Loop checking/Instruments etc. on prorata basis	70%
1.7.1.8.2	On completion of commissioning of main equipment/system on prorata basis	15%
	Total =	85%
1.7.1.9	Other items	
1.7.1.9.1	Completion of work(erection, alignment & testing) of the respective item/equipment	75%
1.7.1.9.2	Completion of Commissioning of the respective item/equipment - on pro rata basis.	10%
	Total=	85%
1.7.1.10	For Supply Items(if applicable)	
1.7.1.10.1	On submission of running bill along with the Stores Receipt /Voucher/Stores endorsement issued by BHEL on prorata basis	85%
	Total=	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)	
1.7.2.2	Boiler Light Up	1%
1.7.2.3	ABO/EDTA	1%
1.7.2.4	Rolling and Synchronisation	1%
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	Completion of painting	2%
1.7.2.11	Monthly Material Reconciliation	1%
1.7.2.12	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.

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VOLUME-IA PART – I CHAPTER - IX BILL OF QUANTITY (BOQ)

NORTH CHENNAI TPS STAGE II 600 MW DETAILED BILL OF MATERIALS FOR ERECTION, TESTING AND COMMISSIONING OF C&I PACKAGE

SL.NO	DESCRIPTION	QUANTITY
A.0	BHEL - TRICHY SCOPE	
A.1.0	FUEL OIL SYSTEM	
A.1.1	PD Type Flow meter (including erection of 2 Nos. Pulse Amplifiers, shielded signal cables, condensing pots etc.).	2 sets*
A.1.2	Level Switches (float type)	06 Nos.
A.1.3	DP Switches	04 Nos.
A.1.4	Pressure Gauges	68 Nos.
A.1.5	Pressure Switches	27 Nos.
A.1.6	Temperature Gauges (capillary type)	12 Nos.
A.1.7	Temperature Switches	5 Nos.
A.1.8	Speed Regulator/ Air Lock Valves/ Air Sets	20 sets*
A.1.9	OD 8 mm Copper Tube	125 Mtrs.
A.1.10	Air Filter Regulators	25 Nos.
A.1.11	FSSS Local Oil Gun Maintenance Switch Box	20 Nos
A.1.12	H.E.A. Exciter box along with retractor assembly, flexible spark rod, spark tip, flexible cable assembly, S.S. Hose (1 Mtr long, 6.35 mm ID), Air Filter Regulator etc.	20 sets*
A.1.13	Flame Scanner Head Assembly with fibre optic cable of length 120", Lens Barrel Assembly, Miniature 6 way Junction Box etc.	32 sets*
A.1.14	Microprocessor based flame scanner amplifier 8 Nos. of 19" Racks of size 482 x 263 x 134 (W x D x H) to be mounted in Flame Scanner Panel (CJF07/ 76) supplied by EDN.	1 set*
A.1.15.0	COMMISSIONING OF THE FOLLOWING	
A.1.15.1	Limit Switches (checking only).	71 Nos.\$
A.1.15.2	Pneumatic Valves: Trip Valves	71 Nos.\$
A.1.15.3	Pneumatic Valves: Regulating Valves	6 Nos.\$
A.2.0	AIR & FLUE GAS SYSTEM	
A.2.1	DP Switches	5 Nos.

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A.2.2	DP Gauges	2 Nos.
A.2.3	Pressure Gauges/ Draft Gauges	08 Nos.
A.2.4	Pressure Switches	08 Nos.
A.2.5	Air Filter Regulators- SADC	8 Nos.
A.2.6	¼" OD PVC Sheathed Copper Tube	2900 Mtrs.
A.2.7	½" OD PVC Sheathed Copper Tube	100 Mtrs.
A.2.8	¼" size Teflon Hose of 2M length	80 Nos.
A.2.9	1" size Teflon Hose of 3M length	04 Nos.
A.2.10	24 way JB, for MTM Thermocouples , App. Wt : 8.5Kg each	55 Nos.
A.2.11	Start/Stop Push Button Box for AH Blower	04 Nos.
A.2.12	Burner Tilt Shear Pin Failure Indication Box Approx. Dimension: 490(W) x 240(D) x 360(H) mm; weight 12 kg each	04 Nos.
A.2.13	Heavy Duty Limit Switch (for Burner Tilt Shear Pin Failure Indication Purpose)	20 Nos.
A.2.14.0	PNEUMATIC POWER CYLINDERS (REGULATING TYPE)	
A.2.14.1	Power Cylinders for SADC (Weight 20 kg each)	80 Nos.
A.2.14.2	PA & FD Fans Blade Pitch Control Dampers (Weight 100 kg each)	04 Nos.
A.2.14.3	ID Fan A&B Inlet Dampers (Weight 1000 kg each)	02 Nos.
A.2.14.4	Cold Air Regulating Dampers (Weight 95 kg each)	09 Nos.
A.2.14.5	Hot Air Regulating Dampers (Weight 175 kg each)	09 Nos.
A.2.14.6	Dynavane Filter Bleed Air Damper (Weight: 100 kg)	1 No.
A.2.15.0	PNEUMATIC ACTUATORS (ON/OFF TYPE)	
A.2.15.1	Scanner Air Emergency Damper (Approximate weight: 60 kg)	1 No.
A.2.16.0	COMMISSIONING OF THE FOLLOWING	
	Pneumatic Power Cylinder (Regulating type)	
A.2.16.1	Burner Tilt Power Cylinders	4 Nos. \$
	Pneumatic Actuators (On/Off Type)	
A.2.16.2	Cold Primary Air Gate	09 Nos. \$
A.2.16.3	Hot Primary Air Gate	09 Nos. \$
A.2.16.4	Feeder Outlet Gate	09 Nos. \$
A.2.16.5	Seal Air to Mill	09 Nos. \$
A.2.16.6	Seal Air Fan Outlet Gate	02 Nos. \$

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A.2.16.7	Air Heater-A&B Sec. Air Outlet Damper Seal Air Knife Edge Gate	02 Nos. \$
A.3.0	PULVERISER SYSTEM	
A.3.1	DP Switches	37 Nos.
A.3.2	Pressure Gauges	01 No.
A.3.3	DP Gauges	01 No.
A.3.4	Pressure Switches	05 Nos.
A.3.5	Temperature Gauges (capillary type)	09 Nos.
A.3.6	Air Filter Regulators (for mill system)	09 Nos.
A.3.7	Purge Meter cum DP regulator	18 Nos.
A.3.8	Pneumatic Pressure Controllers including 1 No. Pneumatic Transmitter, 2 Nos. Air Filter Regulators etc.	2 sets*
A.3.9	Ultrasonic Coal Flow Monitor consisting of detector probe, Control unit, Interconnecting cable between Probe and Control unit, flexible conduit, mounting flanges, fasteners etc. The job includes providing holes in the spacer (spool) pipe at raw coal bunker outlet and welding of two mounting flanges to the pipe facing each other for fixing the instrument.	9 sets*
A.3.10	Gravimetric Feeder Panel Gravimetric Feeder Remote Power Cabinet including keyboard and display Size: 1200 x 600 x 2315 mm; weight: 650 kg each	9 Nos
A.3.11.0	COMMISSIONING OF THE FOLLOWING	
A.3.11.1	Calibration/ Commissioning of Gravimetric Feeder comprising of Feeder Mounted C&I Equipment like motion monitor sensor, micro switches, etc. along with Feeder Integral Cabinet, 2 Nos. LT Motors etc.	9 sets*\$
A.3.11.2	Bunker outlet Gate / Feeder inlet gate Limit Switches (Only checking)	36 Nos. \$
A.4.0	STEAM & WATER SYSTEM	
A.4.1	Pressure Switches	4 Nos.
A.4.2	Pressure Gauges	37 Nos.
A.4.3	Temperature Gauges (capillary type)	11 Nos.
A.4.4	DP Gauge	1 No.
A.4.5	DP Switch	1 No.
A.4.6	Temperature Transmitters	50 Nos.

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A.4.7	Thermocouple Assembly for Smart Soot Blowing System consisting of 2 Nos. Cr-Al thermocouples along with integral terminal box, miniature junction boxes etc.	48 sets*
A.4.8.0	BOILER CIRCULATING WATER PUMP INSTRUMENTS	
A.4.8.1	K Type Duplex Thermocouple	15 Nos.
A.4.8.2	Temperature Switches	02 Nos.
A.4.8.3	Flow Indicators (checking only)	6 Nos. \$
A.4.8.4	Temperature Indicators	3 Nos.
A.4.8.5	Pressure Gauges	3 Nos.
A.4.9.0	CHROMEL - ALUMEL THERMOCOUPLE	
A.4.9.1	MTM T/Cs of route length 14 Mtrs (6 mm OD)	8 Nos.
A.4.9.2	MTM T/Cs of route length 16 Mtrs (6 mm OD)	9 Nos.
A.4.9.3	MTM T/Cs of route length 18 Mtrs (6 mm OD)	11 Nos.
A.4.9.4	MTM T/Cs of route length 20 Mtrs (6 mm OD)	20 Nos.
A.4.9.5	MTM T/Cs of route length 22 Mtrs (6 mm OD)	31 Nos.
A.4.9.6	MTM T/Cs of route length 24 Mtrs (6 mm OD)	53 Nos.
A.4.9.7	MTM T/Cs of route length 26 Mtrs (6 mm OD)	19 Nos.
A.4.9.8	MTM T/Cs of route length 28 Mtrs (6 mm OD)	78 Nos.
A.4.9.9	MTM T/Cs of route length 30 Mtrs (6 mm OD)	9 Nos.
A.4.9.10	MTM T/Cs of route length 32 Mtrs (6 mm OD)	8 Nos.
A.4.9.11	MTM T/Cs of route length 34 Mtrs (6 mm OD)	26 Nos.
A.4.10	Start/ stop Push Button Box for Soot Blower	2 Nos.
A.4.11	ERV Controller with Pressure Switch Dimension: 350 x 290 x 180 mm; weight: 10 kg each	4sets*
A.4.12	Electronic Water Level Indicator EWLI comprising of the following: - 1 No. 16 Port pressure vessel with loose supplied electrodes. - 1 No. Ascetor cabinet of size : 600 x 350 x 600 mm; Weight: 100 kg. - 2 Nos. of Remote Display Unit (Size : 100 x 90 x 234 mm; 5 kg each), 1 no. each at UCB and operating floor. - 1 No. Local indication box. - 10 P x 0.6 sq. mm PTFE probe cable: 30 Mtrs - Interconnecting cables between local panel and electrodes	2 sets*

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A.4.13	Sonic tube leak detection system (BHEL- STLD), comprising the following Sensor Assembly along with head amplifier: 24 sets Junction Box (48 way): 6 Nos. BHEL SONIC Panel: 1 No. Size of the panel: 800 x 800 x 2315 mm; 500 Kg.	1 set*
A.4.14.0	FURNACE FLAME VIEWING SYSTEM	
A.4.14.1	Furnace Flame Viewing System consisting of the following : <ul style="list-style-type: none"> - Camera along with motor operated automatic advance retract mechanism, air system components for lens tube cooling and camera housing cooling, instrument air connection, temperature sensor etc. : 2 Nos. - 2 nos local control unit of size 1220 x 610 x 1470 mm; Weight 100 Kg. - 1 no Remote panel of size 700 x 700 x 2100 mm; Weight 300 Kg in control equipment room along with Monitor, Keyboard etc. - Video cables between camera and monitor - 500 Mtrs. 	1 set*
A.4.15.0	COMMISSIONING OF THE FOLLOWING	
A.4.15.1	Flow Switches (only checking)	4 Nos. \$
A.4.15.2	Direct Water Level Gauges (Fixing of bulbs, holders, wiring and commissioning)	2 Nos. \$
A.4.15.3	Control Valves	10 Nos. \$
A.5.0	HARDWARE LIST	
A.5.1.0	CABLES (PVC, FRLS, Armoured cables for Scanner, Mill feeder, AC Control, and Instruments)	
A.5.1.1	Flame Scanner Cable (2P x 1 sq.mm triple screened, unarmoured cable)	7000 Mtrs.
A.5.1.2	Special Cable for Heat Flux Sensor (2P x 0.5 sq. mm Triple Screened, Unarmoured cable)	800 Mtrs.
A.5.1.3	2P X 1.5 sq. mm, individual and overall shielded, screened armoured cable.	9000 Mtrs.
A.5.1.4	2P X 0.5 sq. mm, individual and overall shielded, screened armoured cable.	2750 Mtrs.
A.5.1.5	2P X 0.5 sq. mm, overall shielded, screened armoured cable.	6550 Mtrs.
A.5.1.6	4P X 0.5 sq. mm, individual and overall shielded, screened armoured cable.	10300 Mtrs.

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A.5.1.7	4P X 0.5 sq. mm, overall shielded, screened armoured cable.	34200 Mtrs.
A.5.1.8	8P X 0.5 sq. mm, individual and overall shielded, screened armoured cable.	5000 Mtrs.
A.5.1.9	8P X 0.5 sq. mm, overall shielded, screened armoured cable.	37500 Mtrs.
A.5.1.10	12P X 0.5 sq. mm, O/A Shielded cable	50 Mtrs.
A.5.1.11	16P X 0.5 sq. mm, overall shielded, screened armoured cable.	600 Mtrs.
A.5.1.12	2 Pair x 1.3 sq. mm, K type, compensating cable	1500 Mtrs.
A.5.1.13	2 Triad x 0.5 sq. mm cables	3000 Mtrs.
A.5.2.0	CABLE TRAY	
A.5.2.1	GI PERFORATED 50MM W	1140 Mtrs.
A.5.2.2	GI PERFORATED 100MM W	3200 Mtrs.
A.5.2.3	GI PERFORATED 150MM W	2500 Mtrs.
A.5.2.4	GI PERFORATED 300MM W	100 Mtrs.
A.5.3.0	JUNCTION BOXES	
A.5.3.1	JUNCTION BOX-12 WAY Approx. weight : 7 Kg each	25 Nos.
A.5.3.2	JUNCTION BOX-24 WAY Approx. weigh : 8.5 Kg each	106 Nos.
A.5.3.3	JUNCTION BOX-36 WAY Approx. weigh : 10 Kg each	01 No.
A.5.3.4	JUNCTION BOX-48 WAY Approx. weigh : 10 Kg each	51 Nos.
A.5.4.0	CHANNELS, PIPES, TUBES ETC.	
A.5.4.1	Structural Steel for fabrication of supports consisting of angles, channels (ISA 40x40x5, ISMC 100x50x6, ISA 50X50X6 etc.)	10.5 MT
A.5.4.2	Flat 50 x 6 mm	300 Mtrs.
A.5.5.0	IMPULSE PIPES	
A.5.5.1	1" SCH 80 Impulse Pipe (CS)	1750 Mtrs.
A.5.5.2	½" SCH 80 Impulse Pipe (CS)	500 Mtrs.
A.5.5.3	AS Pipe, 21.3 X 4.78	200 Mtrs.
A.5.5.4	¾" SCH 80 IMPULSE PIPE, MATL ASTM-A106	600 Mtrs.
A.5.5.5	1/2" SCH 160 Impulse pipe (CS)	200 Mtrs.
A.5.6.0	LOCAL INSTRUMENT RACKS (LIR)	

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A.5.6.1	Local Instrument Racks Size: 1650(W) x 850(D) x 2150(H) mm; Approximate weight: 600 kg each	13 Nos.
B.0	BHEL- RANIPET SCOPE	
B.1.0	AIR PRE-HEATERS	
B.1.1	Pressure Indicators	12 Nos.
B.1.2	Temperature Indicators (with thermowell)	2 Nos.
B.1.3	RTDs	8 Nos.
B.1.4	Pressure Switches	4 Nos.
B.1.5	Thermocouple Assembly consisting of 12 Nos. Cr-Al M. thermocouples along with integral terminal box	4 sets*
B.1.6	Rotor Stoppage Alarm Box- including sensors, interconnecting cables etc.	2 sets*
B.1.7	ON/OFF Switch Box including light assembly and interconnecting cable	2 Nos.*
B.1.8.0	COMMISSIONING OF FOLLOWING	
B.1.8.1	Solenoid Valves	2 Nos.\$
B.1.8.2	Lub oil skids for Air Preheater: The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments etc. The approximate quantity of instruments for each skid is given below: Pressure Gauges – 2 Nos. Temperature Gauges –2 Nos. Flow Switch - 1 No.	4 sets*\$
B.2.0	FANS	
B.2.1	Fan Bearing RTDs	24 Nos.
B.2.2	Fan Bearing Temperature Indicators	24 Nos.
B.2.3	Fan Motor Bearing Temperature Indicators. (Removal, calibration and refixing only)	12 Nos.
B.2.4	Opacity monitoring system (OMS) consists of 1 No sender / receiver unit, 1 No. Reflector unit, 1 No. remote Control Unit, 1 No. Purge air unit with hose, 2 Nos. Fail Safe Shutters, 2 Nos. junction boxes, interconnecting cables, mounting accessories etc. Approximate Weight: 200 kg	4 sets*
B.2.5.0	COMMISSIONING OF THE FOLLOWING	
B.2.5.1	Fan Motor Bearing/ Winding RTDs (checking of healthiness	90 Nos.\$

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	only)	
B.2.5.2	<p>Lub oil skids for FD/ ID/ PA Fans</p> <p>The scope of work includes removal of instruments calibration, refixing, checking cable connection from JB to instruments etc.</p> <p>The approximate total quantity of instruments for all the 06 Nos skids put together is given below:</p> <p>DP Gauges - 06 Nos., Pressure Gauges – 18 Nos , Temperature Gauges – 12 Nos, Diff. Pressure Transmitters-06 Nos, Pressure Transmitters-12 Nos, Pressure Switches – 06 Nos, Level transmitters-06 Nos, Flow indicator with flow switch - 06 Nos.</p>	6 sets* \$
C.0	BHEL - PIPING CENTRE SCOPE	
	S.G. PACKAGE / POWER CYCLE PIPING	
C.1.0	LOCAL/FIELD INSTRUMENTS	
C.1.1	Pressure Gauges	29 Nos.
C.1.2	Temperature Gauges with Thermowell (capillary/ stem type)	108 Nos.
C.1.3	Pressure Switches	02 Nos.
C.1.4	Level Switches (float type)	06 Nos.
C.2.0	JUNCTION BOXES	
C.2.1	Junction Boxes, 12 way/ 18 way	6 Nos.
C.2.2	Junction Boxes, 24 way	1 No.
C.3.0	CABLES	
C.3.1	FRLS, 4 P x 0.5 sq.mm, Cu conductor, screened control cable	150 Mtrs.
C.4.0	GI PIPES (HEAVY DUTY)	
C.4.1	NB 15 x 3.25	2400 Mtrs
C.4.2	NB 25 x 4.05	2395Mtrs
C.4.3	NB 40 x 4.05	270 Mtrs
C.4.4	NB 50 x 4.05	550 Mtrs
C.4.5	NB 80 x 4.8	100 Mtrs.
C.4.6	NB 100 x 5.4	470Mtrs
C.5.0	INSTRUMENT ERECTION MATERIAL	
C.5.1	CS Pipe 21.3 x 3.73	100 Mtrs

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C.6.0	COMMISSIONING OF THE FOLLOWING	
C.6.1	Control Valves	3 Nos. \$
C.6.2	<p>HP dosing (Phosphate) skid</p> <p>The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments etc.</p> <p>The approximate quantity of instruments for each skid is :</p> <p>Pressure Gauges: 2 Nos. DP Gauges: 2 Nos. Pressure Switches: 2 Nos. DP Switches : 2 Nos. Level Switches (float type) :4 Nos. Level gauges - 02 Nos.</p>	1 sets*\$
D.0	EDN SCOPE	
D.1.0	SG PACKAGE	
D.1.1.0	PANELS	
D.1.1.1	<p>Panels : Suite of Two Cubicles (Panel no. CJF07 & 76, CAF16 & 17 , CJF34 & 35</p> <p>Size: 1500 x 750 x 2415 mm; Approx. weight- 800 kg</p>	3 Nos.
D.1.1.2	<p>Panels : Suite of Three Cubicles (Panel no. CJF23,24 & CAF20, CJF25,26&CAF21, CJF27,28 & CAF22, CJF29,30 & CAF23, CJF31,32 & CAF24, CJF58, 59&60)</p> <p>Size: 2250 x 750 x 2415 mm; Approx. weight-1200 kg</p>	6 Nos.
D.1.1.3	<p>Panels : Suite of Four Cubicles(Panel no. CJF51, 52, 66 & 67)</p> <p>Size 3000 x 750 x 2415 mm;Approx. weight-1600 kg</p>	1 No.
D.1.2.0	FIELD INSTRUMENTS	
D.1.2.1	I/P Converters	20 Nos.
D.1.2.2	Air Filter Regulator	20 Nos.
D.1.2.3	Pressure Switch	20 Nos.
D.1.2.4	DP Switch	2 Nos.
D.2.0	TG PACKAGE	
D.2.1.0	PANELS	
D.2.1.1	<p>Single Cubicle Panels : CJJ01, CJJ02, CJJ08, CJJ09, CJJ20, CJJ30</p> <p>Size 750 x 750 x 2415 mm; Approx. weight- 400 kg</p>	6 Nos.

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D.2.1.2	Single Cubicle Panels : TSI for BFPTD-1&2 (CWW01) Size 750 x 750 x 2415 mm; Approx. weight- 400 kg	1 No.
D.2.1.3	Panels : Suite of Two Cubicles (Panel no. CJJ03&04, CJJ11 & 12, CJJ21&22, CJJ23&24, CJJ31&32, CJJ33&34, CCA04&05, CCA06&07, CCA10&11) Size: 1500 x 750 x 2415 mm; Approx. weight- 800 kg	9 Nos.
D.2.1.4	Panels : Suite of Three Cubicles (Panel no. CCA01, CCA02 & CCA03) Size: 2250 x 750 x 2415 mm; Weight. 1200 Kg	1 No.
D.2.1.5	Panels : Suite of Four Cubicles (Panel no. CJJ05, CJJ55, CJJ06 & CJJ56) Size: 3000 x 750 x 2415 mm; Weight. 1600 Kg	1 No.
D.2.1.6	Fire Protection Switch with Junction Box	4 Nos.
D.2.1.7	3 point recorder	1 No.
D.2.2.0	TURBINE SUPERVISORY SYSTEM FOR MAIN TURBINE	
D.2.2.1	Control Cabinet (fully wired), along with 21" monitor, server, printer, Ethernet to FO convertor, interconnecting cables, etc. <u>Approx. Size and Weight of the Panel</u> 800 x 800 x 2415 mm; 600 kg. <u>Total number of loose supplied items to be mounted in the cabinet is as follows:</u> Instrument racks: 02 Nos. along with 14 Nos. of vibration monitor modules, 04 Nos. Power supply modules, 02 Nos. Local Communication Modules, 02 Nos. Host Communication Modules.	1 set*
D.2.3.0	HART MANAGEMENT SYSTEM	
D.2.3.1	Hart Management System (HMS) Comprising of the following : HART Panel- 02 nos., Desktop PC with 22" TFT Monitor-01 no., Colour Inkjet Printer 01 no., and other loose supplied items like Hart master, Hart slave, Patch boards, RS485/RS232 Convertor, interconnecting Cables, etc. <u>Approx. Size and Weight of the Panel</u> 1200(L) x 800(W) x 2415(H) mm; 500 Kg	1 set*

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D.2.4.0	CABLES	
D.2.4.1	2 pair x 0.5 sq. mm PTFE cable	6000 Mtrs.
D.2.4.2	4 pair x 0.5 sq. mm PTFE cable	2000 Mtrs.
D.2.4.3	5 Core x 1.5 sq. mm PTFE control cable	1000 Mtrs.
D.2.4.4	2 Pair x 0.5 sq. mm NiCr-Ni or NiAl Thermocouple Extension cable	12000 Mtrs.
D.2.4.5	2 Pair x 0.5 sq. mm CuCu-Ni compensating cable	3000 Mtrs.
	Cables for TSI System	
D.2.4.6	Fibre optical cable along with HDPE conduit (Cable laying, clamping and dressing to be done by contractor. Splicing would be done by BHEL)	1650 Mtrs.
D.2.4.7	4 Triad x 0.5 sq. mm cables	3000 Mtrs.
D.2.5.0	JUNCTION BOXES	
D.2.5.1	64 way Junction Box	77 Nos.
D.2.5.2	Thermocouple Junction Box for K-type Thermocouple (NiCrNi)	02 Nos.
D.2.5.3	Thermocouple Junction Box for T-type Thermocouple (CuCuNi)	02 Nos.
D.2.6.0	CABLE DUCTS WITH COVERS (GI SOLID BOTTOM)	
D.2.6.1	60 x 60 x 1000 mm	200 Nos.
D.2.6.2	180 x 100 x 1000 mm	200 Nos.
D.2.6.3	250 x 100 x 1000 mm	200 Nos.
D.2.7.0	MOUNTING FRAMES to be assembled & erected <i>Assembly and installation of Mounting Frames with loose supplied prefabricated materials of suitable size, like slotted angles, channels, base plates & fasteners etc.</i>	
D.2.7.1	MFA 150 (1600 x 718 x 1700 mm)	2 Nos.
D.2.7.2	MFC 150 (1600 x 858 x 1700 mm)	2 Nos.
D.2.7.3	MWK 100 (1100 x 300 x 700 mm)	2 Nos.
D.2.7.4	MWG 200 (2100 x 470 x 1700 mm)	3 Nos.
D.2.7.5	MWG 250 (2600 x 470 x 1700 mm)	2 Nos.
D.2.7.6	MFA 100 (1100 x 718 x 1700 mm)	3 Nos.
D.2.7.7	MFA 200 (2100 x 718 x 1700 mm)	2 Nos.
D.2.7.8	MFA 300 (3100 x 718 x 1700 mm)	2 Nos.
D.2.7.9	MFZ 100 (1100 x 424 x 700 mm)	3 Nos.
D.3.0	BOP C&I PACKAGE	

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D.3.1.0	PANELS	
D.3.1.1	Relay Panels and Transducer Panel (Single Cubicle) - CTE01, CTE02, CFA01 Size: 750 x 750 x 2415 mm; Approx. weight- 400 kg	3 Nos.
D.3.1.2	Relay Panel (Common for both units) : Single Cubicle - CTE03 Size: 750 x 750 x 2415 mm; Approx. weight- 400 kg	1 No.
D.3.1.3	Functional Group Control Panel (Suite of Two Cubicles) - CRE01&02, CRE03&04, CRE05&06, CRE07&08, CRE09&10, CRE17&18, CRE19&20, CRE21&22, CRE23&24, CRE25&26, CRE27&28, CRE29&30, CRE31&32, CRE45&46, CRE47&48, CRE49&50, CRE60&61, CRE62&63, CRE64&65, CRE66&67, CRE68&69, CRE91&92 Size:1500 x 750 x 2415 mm; Approx. weight- 800 kg	18 Nos.
D.3.1.4	Functional Group Control Panel (Common for both units) : Suite of Two Cubicles - CRE64&65, CRE66&67, CRE68&69, CRE91&92 Size:1500 x 750 x 2415 mm; Approx. weight- 800 kg	4 Nos.
D.3.1.5	Functional Group Control Panel (Suite of Three Cubicles) - CRE11 to 13, CRE14 to 16, CRE33 to 35, CRE36 to 38, CRE39 to 41, CRE51 to 53 Size: 2250 x 750 x 2415 mm; Approx. weight-1200 kg	6 Nos.
D.3.2.0	FIELD INSTRUMENTS	
D.3.2.1	Pressure Gauges	205 Nos.
D.3.2.2	DP Gauges	25 Nos.
D.3.2.3	Temperature Gauges (capillary type) with thermowell	137 Nos.
D.3.2.4	Thermocouples along with thermowell (K type/ R type)	161 Nos.
D.3.2.5	RTDs along with thermowell	152 Nos.
D.3.2.6	Pressure Switches	40 Nos.
D.3.2.7	DP Switches	7 Nos.
D.3.2.8	Flow Transmitter (Annubar type) along with Impact head type element, protective cover	1 set*
D.3.2.9	Level Gauge, float type, consisting of float, float cable, guide cables, anchor bar, pulley sets along with pulley housing, indicator etc.	1 set*
D.3.2.10	Level gauge (direct mounting type)	1 No.
D.3.2.11	Level switches (capacitance type) with electronic unit	2 Nos.
D.3.2.12	Level switches (float type)	02 Nos.
D.3.2.13	Level switches (conductivity type) with electrodes, vessels and electronic units etc.	2 sets*

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D.3.2.14	Guided Wave Radar Type Level Transmitter	14 Nos.
D.3.2.15	Level Transmitters (DP type)	37 Nos.
D.3.2.16	Hydrostatic Level Transmitter along with control unit	1 No.
D.3.2.17	Ultrasonic Type Level Transmitter	2 Nos.
D.3.2.18	DP Transmitters	36 Nos.
D.3.2.19	Pressure Transmitters	173 Nos.
D.3.2.20	Flow Transmitters	84 Nos.
D.3.2.21	I/P Converters	5 Nos.
D.3.2.22	Air Filter Regulators	05 Nos.
D.3.3.0	GAS ANALYSERS	
D.3.3.1	Low temperature O2 Analyser (In-Situ type) Consisting of probe with Probe Protector, Oxygen Analyser converter, Auto calibration unit enclosure, Double stage gas regulators, Zero gas cylinder, Span gas cylinder, instrument air connection and gas connection tubes, interconnecting power and control cables etc.	5 sets*
D.3.3.2	High temperature O2 Analyser (In-Situ type) Consisting of Zirconia Probe, integral 'B' type Thermocouple, Reference Air Kit, Field JB, Microprocessor based set point controller with communication modules, Reference Gas Cylinder with regulator, Reference air connection and gas connection tubes, interconnecting power and communication cables etc.	2 sets*
D.3.3.3	Opacity Analyser (In-Situ Cross Stack type) Consisting of Transceiver & Reflector unit -01 No each with air purge connections, JBs, 01 No. Air Compressor Unit with air distribution Hose for purge air connection , 01 No. Computer station, inter connecting power & control cables etc. The analyser is to be installed at 71.5 ML of chimney. Weight of compressor unit: 150 kg (approx.)	1set*
D.3.3.4	SOX/NOX/CO (Combined) analyser system - In Situ type Consisting of Probe, Sensor Head, Mounting flange with hardware, Temperature & Pressure Transmitter -01No each, Field mounted Digital Display & Control Unit, Power Supply Unit, Field Mounted Relay Unit, Gas Cylinder, Two Stage SS Regulator for Gas Cylinder, Air dryer unit , SS Tubes 10mm OD - 20 Mtrs, interconnecting power & control Cables etc. The analyser is to be installed at 71.5 ML of chimney.	1 set*
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D.3.4.0	COAL BUNKER LEVEL INDICATING SYSTEM	
D.3.4.1	<p>Coal Bunker Level Indication System comprising of the following :</p> <ul style="list-style-type: none"> - Ultrasonic type Level Sensor with extension cable - 09 nos. - Local Control Panel - 03 nos. - interconnecting cables and other accessories etc. <p>Approx. size and weight of each Panel : 600(W)x360(D)x800(H)mm; 250 Kg.</p> <p>The scope of work includes fabrication & installation of 09 nos. Mounting bracket.</p>	1 set*
D.3.5.0	STEAM AND WATER ANALYSIS SYSTEM(SWAS)	
D.3.5.1	<p>Steam and water analysis system, SWAS consisting of:</p> <p><u>Primary Cooler Rack: 02 Nos.</u> One rack of app. size 2000(L) x 1000(W) x 2215(H) mm & weight 800 kg and the other of app. size, 1000(L) x 800(W) x 2215(H) mm & weight 500kg</p> <p><u>Chiller Unit (100% redundant) : 1 No.</u> Approximate Size 2000(L) x 1400(W) x 1350(D) mm; Dead weight of chiller unit: 1000 kg</p> <p><u>Wet Panel: 1 No.</u> Approximate size 6000(L) x 1000(W) x 2200(H) mm; Weight 1800 kg</p> <p><u>Dry panel: 02 Nos.</u> One rack of approx. size 4800(L) x 800(W) x 2215(H) mm & weight 1200 kg and the other rack of approx. size 1600(L) x 800(W) x 2215(H) mm & weight 500kg</p> <p><u>Conductivity rack : 02 Nos.</u> Each of size 600 x 600 x 1815 mm & Weight 300 Kg.</p> <p>The Wet Panel will be supplied along with associated cooler flow meters, indicators etc.</p> <p>The Dry Panel consists of sensors, electronic instruments etc.</p> <p>The SWAS System will have the following measurements.</p> <p>Cation Conductivity Analyser: 5 Nos. Conductivity Analyser: 13 Nos. Dissolved Oxygen Analyzer : 3 Nos. Hydrazine Analyser: 1 No. Sodium Analyzers(5 Channels) : 1 No. pH Analyzers : 11 Nos. Silica Analyzer(6 Channels) : 1 No.</p>	1 set*

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	<p>Chlorine Analyser - 01 No. Chloride Analyser- 01 No. Phosphate Analyser-01 No. Ammonia Analyser-01 No. The scope of work includes erection of the above, including loose supplied instruments, if any, interconnection pipe between cooler, chiller and wet panel, cooling water connection pipes between cooler, chiller and wet panel etc.</p>	
D.3.6.0	VIBRATION MONITORING SYSTEM for Pumps(BFP/CEP/ CWP/ ECWP), Fans & Motors (Fans, Pumps, Mills)	
D.3.6.1	<p>Control Cabinet (fully wired) Size: 800 x 800 x 2415 mm and approximate weight 500 kg. Out of the Control Cabinets, 3 Nos. will be located in Main Control Room, 1 No. in CWP Control Room and 01 No. in ACWP Control Room. <u>Total number of loose supplied items to be mounted in the 5 cabinets is as follows:</u> Instrument racks: 11 Nos. along with 54 Nos. of vibration monitor modules, 22 Nos. Power supply modules, 11 Nos. Local Communication Modules and 11 Nos. Host Communication Module.</p>	5 sets*
	Accessories for VMS	
D.3.6.2	<ul style="list-style-type: none"> - Velocity Transducer, along with 10 Mtr long Sensor Extension cable with SS conduit (from pickup upto local JB)-196** sets - Eddy Current Sensor , along with 08 Mtr long Sensor Extension cable with SS conduit (from pickup upto Driver housing) - 37** sets - 8 Way FRP Junction Box for Velocity transducer : 98 Nos. (Size:125 x 82 x 167 mm) - Sensor Driver with FRP Enclosure : 37 Nos. (Enclosure Size:139 x 70 x 119 mm) <p>** Installation of sensors with mounting Pads / bracket will be in the scope of vendor, arranged by BHEL. However, assistance for installing the same like drilling, tapping etc., if required, shall be provided by the contractor.</p>	1 set*
D.3.7.0	MAIN UPS WITH ACDB & BATTERY	

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D.3.7.1	<p>2 X 150 KVA UPS comprising of the following :</p> <ul style="list-style-type: none"> - UPS Panel : 02 nos. - Servo controlled voltage stabilizer cubicle : 01 no. - Input Iso. Transformer cubicle : 02 nos. - Wall mounted Battery isolation box : 02 nos. - Wall mounted Tie isolator box : 01 no. - Battery Health Monitoring system consisting of battery detector unit, Power control unit/Monitor, wiring and accessories : 02 sets. <p><u>Approximate Size & Weight :</u> Each UPS Panel : 1640(L) x 900(W)x2110(H)mm; 2000 Kg Each Input Iso. Transformer cubicle: 1000(L) x 1000(W) x 2110(H) mm; 1200 kg. SCVS Cubicle: 1000(L) x 1000(W) x 2110(H) mm; 1500 kg Each Battery Isolation box : 320(L) x 200(W) x 920(H)mm; 50 kg. Tie isolator box - 320(L) x 200(W) x 920(H)mm; 50 Kg.</p>	1 set*
D.3.7.2	<p>ACDB : Approximate Size and weight: 1800(L) x 950(D) x 2135(H) mm; 600 kg.</p>	2 Nos.
D.3.7.3	<p>UPS BATTERY : 600 AH Nickel Cadmium Battery made up of around 291 cells, housed in 2 step 2 tier wooden racks along with inter cell connectors, inter pole connectors, inter row connectors, 01 no. discharge resistor bank, 01 No. cell booster(12V-140A), etc. Each Battery set consists of 08 Nos of Racks Dimensions of Rack1 is 2050(L) x 848(W) x 1550(H) mm , Dimensions of Rack2 to 8 is 1850(L) x 848(W) x 1550(H). Each Cell dimension: 267(L) x 195(W) x 405(H). Each cell weight with electrolyte : 30 Kg. Size of cell booster: 800 x 600 x 1050 mm; 150 Kg.</p>	2 sets*
	CABLES	
D.3.7.4	1X 109/120 sq.mm Copper cable, laying	800 Mtrs.
D.3.7.5	1X 109/120 sq.mm Copper cable, termination	64 nos.
D.3.8.0	24V DC SYSTEM	
	24V CHARGER & BATTERY FOR SG/TG PACKAGE	

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D.3.8.1	<p><u>24V DC/860A Float Cum Boost Charger with DCDB</u>Each set Comprising of the following :- Charger Panels : 02 nos.- DCDB : 01 no.- Wall mounted Battery Isolation Box : 01 no.- Wall mounted Control Panel for Battery Health Monitoring system - 1set- Interconnecting communication cable for BHMS : 100 mtrs. approx.<u>Approximate size and weight:</u> DCDB : 1300(W) x 1200(D) x 2200(H); Weight- 600 Kg.Charger : 2550(W) x 1200(D) x 2200(H) mm, in suitable shipping section; Weight-1200 Kg.Battery Isolation Box : 700(L) x 375(W) x 1250(H); Weight-100 Kg.Each Battery Health Monitoring System Control Panel : 600(L) x 250(W) x 750(H); Weight-25 Kg.</p>	2 sets*
D.3.8.2	<p><u>24V DC Battery for SG/TG Charger System</u></p> <p>513 AH Nickel Cadmium Battery, made up of around 40 cells, housed in 2 step 1 tier wooden racks, along with inter cell connectors, inter pole connectors, inter row connectors, 01 no. discharge resistor bank, 01 No. cell booster(12V-210A), etc.</p> <p>Each Battery set consists of 02 Nos of Racks. Dimensions of each Rack : 2050(L) x 848(W) x 694(H) mm. Each Cell dimension: 267(L) x 195(W) x 349(H). Each cell weight with electrolyte : 26 Kg. Size of cell booster: 800 x 800 x 1050 mm; 200 Kg.</p>	2 sets*
	24V CHARGER & BATTERY FOR BOP PACKAGE	

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D.3.8.3	<p><u>24V DC/1080A Float Cum Boost Charger with DCDB</u></p> <p>Each set Comprising of the following :</p> <ul style="list-style-type: none"> - Charger Panels : 02 nos. - DCDB : 01 no. - Wall mounted Battery Isolation Box : 01 no. - Wall mounted Control Panel for Battery Health Monitoring system - 1set - Interconnecting communication cable for BHMS : 100 mtrs. approx. <p><u>Approximate size and weight</u></p> <p>DCDB : 1300(W) x 1200(D) x 2200(H); Weight- 600 Kg. Charger : 2550(W) x 1200(D) x 2200(H) mm, in suitable shipping section; Weight-1200 Kg. Battery Isolation Box : 700(L) x 375(W) x 1250(H); 100 Kg Each Battery Health Monitoring System Control Panel : 600(L) x 250(W) x 750(H); 25 Kg</p>	02 sets*
D.3.8.4	<p><u>24V DC Battery for BOP Charger System</u></p> <p>600 AH Nickel Cadmium Battery, made up of around 40 cells, housed in 2 step 1 tier wooden racks, along with inter cell connectors, inter pole connectors, inter row connectors, 01 no. discharge resistor bank, 01 No. cell booster(12V-240A), etc.</p> <p>Each Battery set consists of 02 Nos of Racks. Dimensions of each Rack : 2050(L) x 848(W) x 750(H) mm. Each Cell dimension: 267(L) x 195(W) x 405(H). Each cell weight with electrolyte : 30 Kg. Size of cell booster : 800 x 800 x 1050 mm; 200 Kg.</p>	2sets*
	24V CHARGER & BATTERY FOR FOPH	
D.3.8.5	<p><u>24V DC/55A Float Cum Boost Charger with in-built DCDB.</u></p> <p>Each set Comprising of the following :</p> <ul style="list-style-type: none"> - Charger Panel : 01 no. - Wall mounted Battery Isolation Box : 01 no. - Inter connecting communication cables. <p><u>Approximate size and weight</u></p> <p>Charger Panel : 800(W) x 800(D) x 1600(H) mm; 300 Kg Battery Isolation Box : 500(W) x 225(D) x 500(H) mm; 25 Kg</p>	01 set*

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D.3.8.6	<p><u>24V DC Battery for FOPH Charger System</u></p> <p>60 AH Nickel Cadmium Battery made up of around 20 cells, housed in 2 step 1 tier wooden rack along with inter cell connectors, inter pole connectors, inter row connectors, 01 no. discharge resistor bank, 01 No. cell booster(12V-15A), etc. Dimensions of Rack : 650(L) x 534(W) x629(H) mm. Each Cell dimension: 59(L) x 134(W) x 289(H). Each cell weight with electrolyte : 4 Kg. Size of cell booster : 600 x 500 x 1050 mm; 150 Kg.</p>	01 set*
24V CHARGER & BATTERY FOR CWPB		
D.3.8.7	<p><u>24V DC/55A Float Cum Boost Charger with in-built DCDB.</u></p> <p>Each set Comprising of the following :</p> <ul style="list-style-type: none"> - Charger Panel : 01 no. - Wall mounted Battery Isolation Box: 01 no. - Inter connecting communication cables. <p><u>Approximate size and weight</u> Charger Panel : 800(W) x 800(D) x 1600(H) mm; 300 Kg Battery Isolation Box : 500(W) x 225(D) x 500(H) mm; 25 kg</p>	02 sets*
D.3.8.8	<p><u>24V DC Battery for CWPB Charger System</u></p> <p>60 AH Nickel Cadmium Battery made up of around 20 cells, housed in 2 step 1 tier wooden rack along with inter cell connectors, inter pole connectors, inter row connectors, 01 no. discharge resistor bank, 01 No. cell booster(12V-15A), etc Dimensions of Rack : 650(L) x 534(W) x629(H) mm. Each Cell dimension: 59(L) x 134(W) x 289(H). Each cell weight with electrolyte : 4 Kg. Size of cell booster : 600 x 500 x 1050 mm; 150 Kg.</p>	2 sets*
D.3.9.0 LOCAL INSTRUMENT ENCLOSURES/ RACKS		
D.3.9.1	<p>Local Instrument Enclosures (Type - A) Size: 1450(W) x 800(D) x 2300 (H)mm; Approximate weight: 900 kg each</p>	18 Nos.
D.3.9.2	<p>Local Instrument Enclosures (Type - B) Size: 1100(W) x 800(D) x 2300 (H)mm; Approximate weight: 660 kg each</p>	14 Nos.

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D.3.9.3	Local Instrument Enclosures (Type - C) Size: 700(W) x 600(D) x 2100 (H)mm; Approximate weight: 370 kg each	05 Nos.
D.3.9.4	Local Instrument Racks (Type - A) Size: 1600(W) x 850(D) x 2150(H) mm; Approximate weight: 400 kg each	09 Nos.
D.3.9.5	Local Instrument Racks (Type - B) Size: 1300(W) x 850(D) x 2150(H) mm; Approximate weight: 300 kg each	39 Nos.
D.3.9.6	Local Instrument Racks (Type - C) Size: 800(W) x 850(D) x 1600(H) mm; Approximate weight: 200 kg each	20 Nos.
D.3.10.0	CABLES	
	Compensating Cables	
D.3.10.1	2 pair x 1.5 sq.mm 'KX' type T/C cable	3600 Mtrs.
D.3.10.2	4 Pair x 0.5 sq.mm KX type, T/C cable	1200 Mtrs.
D.3.10.3	4 Pair x 1.5 sq.mm KX type, T/C cable	6000 Mtrs.
D.3.10.4	6 Pair x 1.5 sq.mm KX type, T/C cable	10000 Mtrs.
D.3.10.5	2 pair x 1.5 sq.mm 'SX' type T/C cable	1500 Mtrs.
	PVC/FRLS, armoured, individually and overall shielded, Cu cables	
D.3.10.6	2 pair x 0.5 sq. mm cable	3000 Mtrs.
D.3.10.7	4 pair x 0.5 sq. mm cable	60500 Mtrs.
D.3.10.8	6 pair x 0.5 sq. mm cable	50 Mtrs.
D.3.10.9	8 pair x 0.5 sq. mm cable	10000 Mtrs.
D.3.10.10	12 pair x 0.5 sq. mm cable	10000 Mtrs.
D.3.10.11	2 Triad x 0.5 sq.mm cable	6000 Mtrs.
	PVC/FRLS, armoured, Overall shielded, Cu Cables	
D.3.10.12	2 pair x 0.5 sq. mm cable	13000 Mtrs.
D.3.10.13	4 pair x 0.5 sq. mm cable	43500 Mtrs.
D.3.10.14	8 pair x 0.5 sq. mm cable	18500 Mtrs.
D.3.10.15	12 pair x 0.5 sq. mm cable	17000 Mtrs.
D.3.10.16	24 pair x 0.5 sq. mm cable	50 Mtrs.
D.3.10.17	1 pair x 1.5 sq. mm cable	50 Mtrs.
D.3.10.18	2 pair x 1.5 sq. mm cable	2000 Mtrs.
D.3.10.19	2C x 2.5 sq. mm cable	7000 Mtrs.
D.3.11.0	CABLE TRAYS WITH COVERS	

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D.3.11.1	Perforated Cable Trays, 50 mm wide	3500 Mtrs.
D.3.11.2	Perforated Cable Trays, 100 mm wide	4000 Mtrs.
D.3.12.0	JUNCTION BOXES	
D.3.12.1	12 way Junction Boxes	18 Nos.
D.3.12.2	24 way Junction Boxes	23 Nos.
D.3.12.3	36 way Junction Boxes	15 Nos.
D.3.12.4	48 way Junction Boxes	10 Nos.
D.3.12.5	64 way Junction Boxes	08 Nos.
D.3.12.6	72 way Junction Boxes	02 Nos.
D.3.12.7	96 way Junction Boxes	13 Nos.
D.3.13.0	IMPULSE PIPES	
D.3.13.1	A106 Gr C 3/4" NB SCH 80	2500 Mtrs.
D.3.13.2	ASTM A106 GR C 1" NB SCH 80	275 Mtrs.
D.3.13.3	A106 Gr C- 1/2" NB SCH 160	1300 Mtrs.
D.3.13.4	A106 Gr C- 1/2" NB SCH 80	4200 Mtrs.
D.3.13.5	A335 P22- 1/2" NB XXS	650 Mtrs.
D.3.13.6	A213 TP 316 – 1/2" NB SCH160	650 Mtrs.
D.3.13.7	A213 TP316H 1/2" NB SCH 80	750 Mtrs.
D.3.13.8	A312 TP316L GR C 1/2" NB SCH 40	1500 Mtrs.
D.3.14.0	OTHER ERECTION MATERIALS	
D.3.14.1	100 x 50 x 5 mm MS Channels, 50 X 50 X 5 MS angles, 250 x 10 mm MS Flat, 500 x 3.15 mm MS Flat etc.	11 MT
D.3.14.2	1/2" heavy duty GI pipes	3500 Mtrs.
D.3.14.3	1" heavy duty GI pipes	170 Mtrs.
D.3.14.4	1/4" OD, SS Tubes	170 Mtrs.
D.3.15.0	MASTER AND SLAVE CLOCK SYSTEM	
D.3.15.1	Master clock System PanelSize: 900 x 600 x 2415 mm; 300 kg approx.	1 No.
D.3.15.2	Slave clock Approximate Size: 700(W) x 110(D) x 200(H) mm	25 Nos.
D.3.15.3	GPS Antenna , Lightning Arrestor along with approx. 100 Mtrs of interconnecting cable from antenna to GPS receiver unit.	01 No.
D.3.15.4	Slave Booster	05 Nos.
D.3.15.5	Line Driver / Receiver	02 sets
D.3.15.6	RG 58 Coaxial Cable	1750 Mtrs.
D.3.15.7	RS 232/485 Data Cable	500 Mtrs.

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D.3.15.8	3C x 1.5 sq. mm Power Supply Cable.	1250 Mtrs.
D.3.15.9	Network Cable	250 Mtrs.
D.3.15.10	GI conduit Pipe, 19mm OD.	500 Mtrs.
D.3.15.11	Junction Box	5 Nos.
D.3.16.0	CCTV SYSTEM	
D.3.16.1	CCTV System Local Control Panel <u>Approximate Size and Weight</u> 800 x 800 x 2415 mm; 300 kg	2 Nos.
D.4.0	HMI PACKAGE	
D.4.1	<u>CRT DESK</u> Unit Control Desk for housing Work Stations, CRTs, keyboards and mouse for the above etc. Approximate Total size 9100(L) x 951(W) x 760(H) mm, in suitable shipping sections.	1 No.
D.4.2	<u>LVS SYSTEM</u> 6 nos. of 67" Large Video Screen along with CPU and other loose supplied items like Video controller, Border binder, interconnecting power & communication cables, Mounting stand / arrangement etc. Approx. size of stand : 1500(W) x 835(D) x 1600(H) mm.	1 set*
D.4.3	<u>COMPUTER STATIONS</u> PCs along with 21" TFT monitor, and other loose supplied items like keyboard, mouse, modems, 1kVA UPS, printer & print servers, interconnecting power and communication cables etc. The PCs are for various specific functions like Engineer Workstation (Programmer Station/ system documentation station), Shift In charge Station, 'maxStorian' Station (Information system), Operator Work Stations ('maxOperator' Stations), maxLINK Stations, MIS PC, Auxiliary Location Unit Monitoring Station, TSC Operator Workstation, CWPH & FOPH Operator Workstation, Plant wide network stations etc. The scope of work includes erection of the above including associated PC/printer furniture & operator chairs, integration of the system and commissioning.	40 sets*
D.4.4	Network Panels / HMI cum Link Panel/ PDU Panel Dimension: 750 x 750 x 2415 mm; Approximate Weight: 400 kg	5 Nos.

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D.4.5	Network Enclosures (Wall Mounted type), along with loose supplied Ethernet switches. Dimension: 600 x 600 x 500 mm; Approximate Weight: 50 kg	3 Nos.
	Cables for MMI Package	
D.4.6	Ethernet Cable	12500 Mtrs.
D.4.7	Power Cables: 4 C x 1.5 sq. mm cables	1500 Mtrs.
D.5.0	PADO SYSTEM	
D.5.1	PADO Servers along with 24" monitors and other loose supplied items like keyboard, mouse, printers, 1 kVA UPS, interconnecting power and communication cables, furniture etc. and other accessories like Ethernet Switches, ISDN Modem, ISDN NT, Light interface unit etc. The scope of work includes erection of the above including associated furniture & operator chairs, integration of the system and commissioning.	1 set*
D.5.2	Operator Workstations PCs along with 24" monitor, and other loose supplied items like keyboard, mouse, interconnecting power and communication cables etc. The scope of work includes erection of the above including associated furniture & operator chairs, integration of the system and commissioning.	8 sets*
D.5.3	Power Distribution Boards 15A/ 5A	12 Nos.
D.5.4	Ethernet Cable	350 Mtrs
D.5.5	Conduit for laying Ethernet cable	350 Mtrs
D.5.6	Wall mounted Rack / 6U Wall mounted rack	2 Nos.
E.0	BHEL-HYDERABAD SCOPE	
E.1.0	PUMPS (TDBFP, MDBFP, CEP)	
E.1.1	INSTRUMENTS	
E.1.1.1	RTDs along with thermowells	120 Nos.
E.1.1.2	Temperature Indicators of BFP, CEP & other motors (Removal, calibration & re-fixing only)	32 Nos.
E.1.2.0	IMPULSE TUBES	
E.1.2.1	Impulse tube, Dia 16 x 2.6, CS	1900 Mtrs.
E.1.3.0	JUNCTION BOXES	
E.1.3.1	Electrical Junction Box, 12 terminals	06 Nos.

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E.1.3.2	Electrical Junction Box, 24 terminals	06 Nos.
E.1.4.0	CABLES/ CABLE TRAYS	
E.1.4.1	4 Triad, 0.5 sq. mm cable	500 Mtrs.
E.1.4.2	4 Pair, 0.5 sq. mm cable	500 Mtrs.
E.1.4.3	Perforated cable tray, 50 mm wide	80 Mtrs.
E.1.4.4	Perforated cable tray, 150 mm wide	45 Mtrs.
E.1.5.0	LOCAL GAUGE BOARD (LGB) / LOCAL INSTRUMENT RACK (LIR) (including removal, calibration and re-fixing of LGB mounted instruments)	
E.1.5.1	LGB Assembly for Feed Water Service for TDBFP/MD BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1400 x 550 x 1900 mm ; Weight = 200 kg each. Quantity of instruments per set is Pressure Gauge: 5 Nos. DP Gauges: 2 Nos. Temperature Gauges: 2 Nos.	03 Nos.
E.1.5.2	LGB Assembly for Oil, Seal and Cooling Water Service of TD/MD BP & BFP including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1400 x 550 x 1900 mm ; Weight = 200 kg each. Quantity of instruments per set is Temperature Gauges: 12 Nos. Pressure Gauge - 08 Nos.	03 Nos.
E.1.5.3	LGB Assembly for 3 Nos. CEP Suction side including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1400 x 550 x 1900 mm; Weight = 200 kg each. Quantity of instruments per set is Pressure Gauges: 3 Nos. Diff. pressure Gauges: 03 Nos.	01 No.
E.1.5.4	LGB Assembly for 3 Nos. CEP Discharge side including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JB's. Approximate Size 1400 x 550 x 1900 mm; Weight = 200 kg each. Quantity of instruments per set is Pressure Gauges: 6 Nos. Temperature Gauges: 03 Nos.	01 No.

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E.1.5.5	Local instrument rack (LIR) assembly for TDBFP/MDBFP, including transmitters, tubing, fittings, JBs, Main-fold valves and wiring from JBs to transmitters. Approximate Size 2000 x 650 x 2200 mm; Weight = 300 kg each. Quantity of instruments per set is DP transmitters: 02 Nos. Pressure transmitter : 04 Nos.	03 Nos.
E.1.5.6	Local instrument rack (LIR) assembly for BFPs(1 MD + 2 TD), including transmitters, tubing, fittings, JBs, Main-fold valves and wiring from JBs to transmitters. Approximate Size: 2000 x 650 x 2200 mm; Weight = 300 kg Quantity of instruments per set is Pressure transmitters: 3 Nos. DP transmitters: 8 Nos.	01 No.
E.1.5.7	Local Instrument Rack (LIR) assembly for CEP-A,B&C, including Transmitters, tubing, fittings, JBs, Manifolds Valves and wiring from JBs to transmitters Approximate Size: 2000 x 600 x 1500 mm; Weight = 300 kg Quantity of instruments per set is Differential Pressure transmitters: 3 Nos. Pressure transmitters: 6 Nos	01 No.
E.1.6.0	SUPPORT MATERIALS	
E.1.6.1	Structural steel (ISMC 100 x 50 mm, Angle 45 x 45 x 5 mm etc.)	1 MT
E.1.7.0	CHECKING AND COMMISSIONING OF THE FOLLOWING	
E.1.7.1	RTDs fixed on BFP, CEP & other motors (Checking healthiness only)	182 Nos. \$
E.1.7.2	Hydraulic Coupling of MDBFP The scope of work covers A) Removal, calibration & refixing of instruments. The approximate quantity of instruments is as follows. Pressure Indicators: 2 Nos. DP Indicator: 1 No. Temperature Indicators: 14 Nos. Pressure Transmitters: 6 Nos. Level transmitter: 1 No. DP transmitter: 1 No. RTDs (Checking only): 18 Nos. B) Fixing of I/P Convertors, Air filter, Copper tubing & feedback transmitter, adjustment and calibration of scoop mechanism etc. C) Commissioning of Speed Indicators etc.	1 set\$

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E.1.7.3	Limit Switch (checking only)	18 Nos. \$
E.2.0	BFP DRIVE TURBINE	
E.2.1.0	INSTRUMENTS (LOCAL/FIELD MOUNTED)	
E.2.1.1	Pressure Gauges	70 Nos.
E.2.1.2	DP Gauges	08 Nos.
E.2.1.3	Pressure Transmitters	50 Nos.
E.2.1.4	Pressure Switches	6 Nos.
E.2.1.5	DP Switches	8 Nos.
E.2.1.6	Temperature Gauges with thermowell (capillary type)	48 Nos.
E.2.1.7	RTDs with thermowell	44 Nos.
E.2.1.8	Cr-Al Thermocouples with thermowell	16 Nos.
E.2.1.9	Level gauge (direct mounting type)	02 Nos.
E.2.1.10	Level Transmitters (capacitance type, top mounted) along with probes, electronic unit etc.	4 sets*
E.2.1.11	Speed measuring loop, with probe, proximeter unit, local field cable etc. for Governing System	12 Sets*
E.2.1.12	I/P Converter	6 Nos.
E.2.1.13	Flow Transmitter	02 Nos.
E.2.2.0	PANEL / FIELD MOUNTED INSTRUMENTS	
E.2.2.1	TSI System for BFP Drive Turbine consisting of the following- <ul style="list-style-type: none"> - 2 Nos. Monitor rack with modules (to be mounted on panel) approximate wt 40 kg per rack. - 16 Nos. of Vibration/Axial displacement probes with probe extension cables - 16 Nos. of Probe Drivers - 10 Nos. of Driver housing - 10 Nos. of temperature sensors with extension cables - 02 Nos. of JB for temp. sensor(Size:125 x 82 x 167 mm) - Flexible conduit, interconnecting cables(approx. 150 mtrs.) etc. 	2 Sets*
E.2.2.2	Fabrication of Local Instrument Racks, each of size 1500 x 1700 mm, with the following material Channel ISMC 100 x 50 mm, Angle 50 x 50 x 6 mm, Plate 10 mm thick (375 x 770 mm), Sheet 4 mm thick (400 x 120 mm) etc.	2 MT

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E.2.3.0	IMPULSE PIPES & FITTINGS	
E.2.3.1	CS Pipe, ½" SCH 80 (21.3 x 3.73)	1015 Mtrs.
E.2.3.2	CS Pipe, 60.3 x 3.91	310 Mtrs.
E.2.3.3	Cr-Al Pipe 21.3 x 3.73	660 Mtrs
E.2.3.4	SS tube, 12.7 x 2.1 mm	300 Mtrs
E.2.3.5	SS tube, 6 x 1.5 mm	60 Mtrs
E.2.4.0	CHECKING AND COMMISSIONING OF THE FOLLOWING	
E.2.4.1	Control Valves	20 Nos. \$
E.2.4.2	Position Transmitters	8 Nos. \$
E.2.4.3	Governing Console Board The scope includes removal, calibration and refixing of Instruments, wiring etc. The approximate quantity of instruments is Pressure Gauges: 10 Nos. Pressure Switches: 24 Nos.	2 sets*\$
E.3.0	HEAT EXCHANGERS (LPH 2&3, HPH 5A, 5B, 6A & 6B) AND DE-AERATOR	
E.3.1	Pressure Gauges	19 Nos.
E.3.2	Level Switches (float type)	3 Nos.
E.3.3	Temperature Gauges with thermowell (capillary type)	09 Nos.
E.4.0	PULVERISER	
E.4.1	RTDs along with thermowell	54 Nos.
E.4.2	Temperature Indicators (Removal, calibration and refixing only)	18 Nos.
E.4.3.0	COMMISSIONING OF FOLLOWING	
E.4.3.1	Mill Motor RTDs - bearing/ winding (Checking healthiness only)	126 Nos.\$

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E.4.3.2	Pulveriser Lub Oil Skid Removal, calibration and re-fixing of following instruments, checking of wiring from skid junction box to equipment in lub oil skid. Equipment per set DP Switch – 1 No. DP indicator – 1 No. Level Switches- 2 Nos. Pressure Gauge- 3 Nos. Pressure switches- 2 nos Temperature Gauges- 3 Nos. Temperature switches- 6 Nos. RTDs – 6 Nos. Flow switch - 2 Nos.	9 sets*\$
	Pneumatic Actuators of On/Off type	
E.4.3.3	Seal Air to Pulveriser Coal pipes	9 Nos. \$
E.4.3.4	Mill Discharge Damper	36 Nos. \$
E.5.0	CW PUMPS	
E.5.1.0	INSTRUMENTS	
E.5.1.1	Pressure Gauge	06 Nos.
E.5.1.2	Pressure Switch	12 Nos.
E.5.1.3	Level Switch (Float type)	30 Nos.
E.5.1.4	Temperature gauge	06 Nos.
E.5.1.5	RTDs along with thermowells	18 Nos.
E.5.1.6	Temperature Indicators of CWP motors (Removal, calibration & re-fixing only)	30 Nos.
E.5.1.7	CWP Motor RTDs - bearing/ winding (Checking healthiness only)	84 Nos.\$
E.5.1.8	Reverse Rotation Monitoring System for CWP consisting of 7 Nos. reverse rotation monitor modules (to be mounted in VMS Panel) , Eddy Current Sensor- 12 nos, Mounting brackets, Driver for sensor-12 nos, Driver housing- 06 Nos & Sensor extension cable with conduit etc.	1 set*
F.0	BHEL-PEM SCOPE	
F.1.0	INSTRUMENTS	
F.1.1	DP Transmitters	2 Nos.
F.1.2	DP Switches	2 Nos.
F.1.3	Pressure Switches	2 Nos.

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F.2.0	CONDENSER ONLINE TUBE CLEANING SYSTEM	
F.2.1	PLC panel for Condenser Tube Cleaning system, along with monitor, keyboard etc. Approximate size : 1200 x 600 x 1800 mm; 600 kg	1 No.
F.2.2	Pressure Gauges	1 No.
F.2.3	DP Gauges	1 No.
F.2.4	DP Transmitters	2 Nos.
F.2.5	DP Switches	2 Nos.
F.2.6	Pressure Switches	2 Nos.
F.3.0	INSTRUMENTATION CABLES	
	Individual Pair & Overall Shielded, Twisted Pair, Armoured cables	
F.3.1	4 Pair x 0.5 mm ²	80500 Mtrs.
F.3.2	8 Pair x 0.5 mm ²	21500 Mtrs.
F.3.3	12 Pair x 0.5 mm ²	10500 Mtrs.
F.3.4	20 Pair x 0.5 mm ²	9500 Mtrs.
	Overall Screened, Twisted Pair, Armoured cables	
F.3.5	2 Pair x 0.5 mm ²	6500 Mtrs.
F.3.6	4 Pair x 0.5 mm ²	149500 Mtrs.
F.3.7	8 Pair x 0.5 mm ²	27500 Mtrs.
F.3.8	12 Pair x 0.5 mm ²	18000 Mtrs.
F.3.9	2 Pair x 1.5 mm ²	1000 Mtrs.
F.4.0	COMMISSIONING OF FOLLOWING	
F.4.1	Control Valves	33 Nos. \$
F.4.2	Hydrazine Dosing Skid Approximate qty of instruments per skid is Pressure Gauges: 2 Nos. Pressure Transmitter: 1 No. DP Indicating Transmitter: 1 No. Level Transmitter: 1 No.	1 No. \$
F.4.3	Ammonia Dosing Skid Approximate qty of instruments per skid is Pressure Gauges: 2 Nos. Pressure Transmitter: 1 No. DP Indicating Transmitter: 1 No. Level Transmitters: 2 Nos.	1 No. \$

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F.4.4	NaOH Dosing Skid Approximate qty of instruments per skid is Level Switch: 1 No.	1 No. \$
G.0	BHEL- HARDWAR SCOPE	
G.1.0	GENERATOR	
G.1.1.0	GENERATOR AUXILIARY CONTROL CABINETS	
G.1.1.1	Generator Instrumentation Cabinet (CXW01B) Approx.size & weight: 1000 x 800 x 2200 mm; 450 kg	1 No.
G.1.1.2	Gas Analyser Cabinet including sensor, analyser etc. Approx. size & weight: 1200 x 800 x 2200 mm; 400 kg	2 sets *
G.1.1.3	Generator End Winding Vibration Monitoring System comprising of Panel, pre-amplifier units, special cables for interconnecting the probes and amplifiers, PC based vibration monitor, printer, etc. Approximate size & weight of the panel : 800 x 800 x 2200 mm; 150 Kg.	1 No.
G.1.1.4	Moisture Measurement System for Generator, including panel. Approximate weight of panel : 300 Kg.	1 set *
G.1.1.5	Grounding Brush Monitor comprising of Detector Unit (wall mounting type) to be mounted near the shaft and Monitor Unit (Flush panel mounting type) to be mounted in control room Approx size of Detector Unit: 235 x 285 x 145 mm Approx Size of Monitor Unit: 280 x 285 x 120 mm	1 set *
G.1.2.0	GENERATOR INSTRUMENTS:	
G.1.2.1	Pressure Gauges	33 Nos.
G.1.2.2	Temperature Gauges	15 Nos.
G.1.2.3	Thermostat	1 No.
G.1.2.4	Pressure Transmitters	16 Nos.
G.1.2.5	Differential Pressure Transmitters	04 Nos.
G.1.2.6	Level Transmitter	1 No.
G.1.2.7	Level Switches (capacitance type)	15 Nos.
G.1.2.8	RTDs	18 Nos.
G.1.2.9	Pressure Switches	02 Nos.
G.1.2.10	Thermocouples (NiCrNi) (Generator Bearing Temp: 4 Nos. Exciter Bearing Temp: 2 Nos.)	6 Nos.

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G.1.3.0	REMOVAL, CALIBRATION & RE-FIXING OF GENERATOR INSTRUMENTS	
G.1.3.1	Pressure Gauges	13 Nos.
G.1.3.2	DP Gauges	2 Nos.
G.1.3.3	Temperature Gauges	9 Nos.
G.1.3.4	Pressure Transmitters	10 Nos.
G.1.3.5	Differential Pressure Transmitters	5 Nos.
G.1.3.6	Pressure Switches	8 Nos.
G.1.3.7	Level Switches	7 Nos.
G.1.3.8	Flow Meters (commissioning only)	13 Nos. \$
G.1.3.9	Conductivity Cells	2 Nos.
G.1.3.10	PW Conductivity Indicator	1 No.
G.1.3.11	Flow Indicators (commissioning only)	1 No.\$
G.1.3.12	Checking the healthiness of the following RTDs/Thermocouples Temperature- Stator Core (TC CuCuNi) : 24 Nos. Temperature- Stator Slot (Pt 100 RTD): 12 Nos. Temperature- PW outlet manifold (Pt 100 RTD): 6 Nos. Temp- Hot Gas After H ₂ Coolers (Pt 100 RTD): 4 Nos. Temp- Cold Gas After H ₂ Coolers (Pt 100 RTD): 12 Nos. Temp- Cold Gas (Pt 100 RTD): 4 Nos. Temp- Cold Air Main Exciter (Pt 100 RTD): 4 Nos. Temp- Hot Air Main Exciter (Pt 100 RTD): 6 Nos. Temp- Hot Air Rectifier Wheel (Pt 100 RTD): 2 Nos. Temp- PW at I/L to SW (Pt 100 RTD): 6 Nos. Temp - SW at O/L (Pt 100 RTD): 2 Nos. Temp after M. Bushing(Pt 100 RTD): 02 Nos. Temp before H ₂ coolers (Pt 100 RTD): 04 Nos. Temp after H ₂ coolers (Pt 100 RTD): 10 Nos. Temp after exciter coolers (Pt 100 RTD): 04 Nos. Temp at I/L of air coolers (Pt 100 RTD): 04 Nos. Temp CO ₂ Flash Evap. : 2 Nos. Temp at I/L of PW Cooler (Pt 100 RTD) : 2 Nos. Temp at O/L to PW Cooler (Pt 100 RTD) : 4 Nos.	114 Nos.\$
G.1.4.0	LOOSE SUPPLIED INSTRUMENTS FOR GENERATOR PIPING	
G.1.4.1	Vacuum Switches	2 Nos.
G.1.4.2	Pressure Gauges	7 Nos.
G.1.4.3	Pressure Switches	1 No.
G.1.4.4	Pt RTD, Duplex	2 Nos.
G.1.4.5	Bimetallic Dial Thermometer	5 Nos.

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G.1.5.0	LOOSE SUPPLIED INSTRUMENTS FOR H2 COOLER PIPING	
G.1.5.1	Pressure Gauges	8 Nos.
G.1.5.2	Pressure Switches	1 No.
G.1.5.3	Pt RTD, Duplex	17 Nos.
G.1.5.4	Bimetallic Dial Thermometer	6 Nos.
G.1.5.5	Moisture Sensor Probes	2 Nos.
G.1.6.0	LOOSE ITEMS TO BE MOUNTED ON UCB	
G.1.6.1	Digital Indicators	6 Nos.
G.1.6.2	Bar Graph Indicators	2 Nos.
G.1.7.0	IMPULSE PIPES	
G.1.7.1	21.3 x 2.3 CS pipe	200 Mtrs.
G.1.7.2	21.3 x 2.3 AS pipe	250 Mtrs.
G.1.7.3	21.3 x 2.3 SS pipe	800 Mtrs.
G.1.7.4	13.5 x 2.6 CS pipe	100 Mtrs.
G.1.7.5	13.5 x 2.6 AS pipe	50 Mtrs.
G.1.7.6	13.5 x 2.6 SS pipe	100 Mtrs.
G.1.7.7	17.2 x 1.8 CS pipe	20 Mtrs.
G.2.0	STEAM TURBINE	
G.2.1.0	GAUGES AND SENSORS	
G.2.1.1	RTDs	28 Nos.
G.2.1.2	Thermocouples	135 Nos.
G.2.1.3	Temperature Gauges	18 Nos.
G.2.1.4	Temperature Switches	3 Nos.
G.2.1.5	Pressure Transmitters/ Absolute Pressure Transmitters	58 Nos.
G.2.1.6	DP Transmitters	08 Nos.
G.2.1.7	Pressure Switches	37 Nos.
G.2.1.8	DP Switches (Removal, calibration & re-fixing only)	11 Nos.
G.2.1.9	Pressure Gauges	84 Nos.
G.2.1.10	Level transmitters with amplifier, bar probe	09 sets*
G.2.1.11	Level Switches (Float type)	07 Nos.
G.2.1.12	Position Transmitters for Extraction NRV	16 Nos.
G.2.1.13	Level Switch (Conductivity type) with electronic unit	2 sets*.
G.2.1.14	Flow transmitters	03 Nos.
G.2.1.15	Temperature transmitters	02 Nos.

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G.2.2.0	PRESSURE INSTRUMENTS RACKS (IR1 to IR13) Assembly/welding and installation of Instrument Racks with loose supplied prefabricated materials of suitable size, like equal/unequal angles, canopy mounting plates, LHS/RHS stands etc., necessary welding, fixing with fasteners and grouting Total wt. of loose supplied items for 13 racks: Approx. 3 Tonnes	
G.2.2.1	Rack of Size 2150 x 700 x 2150 (WXDXH) mm	11 Nos.
G.2.2.2	Rack of Size 1250 x 700 x 2150 (WXDXH) mm	2 Nos.
G.2.3.0	IMPULSE PIPES	
G.2.3.1	Carbon Steel Tube, D=13.5 x 2.6	554 Mtrs.
G.2.3.2	CS Tube DN-80	40 Mtrs.
G.2.3.3	Carbon Steel Tube, D=21.3 x 2.3	510 Mtrs.
G.2.3.4	Seamless S.S. tube D=21.3 x 2.6	330 Mtrs.
G.2.3.5	Seamless S.S. tube D=13.5 x 2.6	30 Mtrs.
G.2.3.6	Seamless alloy steel tube D=21.3 x 2.77	485 Mtrs.
G.2.3.7	Seamless alloy steel tube D=13.5 x 2.6	20 Mtrs.
G.2.4.0	JUNCTION BOXES	
G.2.4.1	Junction Box (Pedestal and Proximeter JB)	17 Nos.
G.2.4.2	80 pt. Junction Box	02 Nos.
G.2.4.3	48 pt. junction box	02 Nos.
G.2.4.4	Thermocouple JB for HPC & IPC	02 Nos.
G.2.5	STRUCTURAL STEEL (for both turbine and generator instruments)	1 MT
G.2.6.0	INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER-1, TOC, CFC)	
G.2.6.1	Level Switches (Float type)	5 Nos.
G.2.6.2	Temperature Gauges with thermowell	20 Nos.
G.2.6.3	Pressure Gauges	3 Nos.
G.3.0	COMMISSIONING OF THE FOLLOWING	

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G.3.1	<p>Condenser Vacuum Pump Removal, calibration and commissioning of CVP skid mounted instruments including CVP PLC and motor mounted on the skid. The approximate quantity of skid mounted instruments shall be</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Pressure Indicators – 2</td> <td style="width: 50%;">Temperature Indicators - 2</td> </tr> <tr> <td>Flow Indicator – 1</td> <td>Flow Switch – 1</td> </tr> <tr> <td>Level Switches – 2</td> <td>DP Switch – 1</td> </tr> <tr> <td>Pressure Switch – 1</td> <td>Temperature Switch- 1</td> </tr> <tr> <td>Limit Switch – 1</td> <td>Solenoid Valve – 2</td> </tr> </table>	Pressure Indicators – 2	Temperature Indicators - 2	Flow Indicator – 1	Flow Switch – 1	Level Switches – 2	DP Switch – 1	Pressure Switch – 1	Temperature Switch- 1	Limit Switch – 1	Solenoid Valve – 2	2 sets*\$
Pressure Indicators – 2	Temperature Indicators - 2											
Flow Indicator – 1	Flow Switch – 1											
Level Switches – 2	DP Switch – 1											
Pressure Switch – 1	Temperature Switch- 1											
Limit Switch – 1	Solenoid Valve – 2											
G.3.2	<p>Oil Centrifuge Unit Removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system.</p>	2 Nos.\$										
G.3.3	NRV Valves, Stop Valves, Control Valves, HP/LP Bypass Valves	40 Nos. \$										
G.3.4	Position Transmitters (Removal, calibration and re-fixing)	20 Nos.										
G.3.5	Limit Switch (checking only)	76 Nos. \$										
G.3.6	Solenoid Valves (checking only)	30 Nos. \$										
G.3.7	<p>Hydraulic Speed Control Equipment Rack (LR1) Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 9 Nos. Pressure Switches : 4 Nos.</p>	1 set*\$										
G.3.8	<p>LP Bypass Control Rack (LR2) Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. The approximate quantity of instruments is as below: Pressure Gauges : 11 Nos. Pressure Switch : 1 No.</p>	1 set*\$										
G.3.9	<p>Supply Unit Racks for HP Valve-1, HP Valve-2, IP Valves (SU1, SU2 & SU3) Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc. Total quantity of instruments for all 3 racks is as below: Pressure Gauges : 17 Nos. Pressure Switches: 12 Nos DP Switches : 3 Nos.</p>	3 sets*\$										
G.3.10	Seal Oil Rack	1 set*\$										

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G.3.11	Stator Water Rack	1 set*\$
G.3.12	Seal Oil Level / Pr Txr Instrument Rack	1 set*\$
G.3.13	Stator Water DP Instrument Rack	1 set*\$
G.3.14	H2 Dryer Unit	1 set*\$
G.3.15	Gland Steam And Seal Steam Oil Supply Units	2 sets*\$
G.3.16	TD BFP Pump Coupling Engage Oil Supply Unit	2 sets*\$
H.0	FOR EDTA CLEANING	
H.1.0	Calibration (as required), Erection, Removal and Handing Over to BHEL Stores	
H.1.1	MTM thermocouple length 10 mtrs	12 Nos.
H.1.2	Junction boxes - 12 way/ 6 way/ 24 way	10 Nos.
H.1.3	Compensating cables 2 P x 0.5 sq. mm	200 Mtrs.
H.1.4	Compensating cables 6 P x 0.5 sq. mm	300 Mtrs.
H.1.5	Pressure gauges	5 Nos.
H.1.6	Drum MTM thermocouple adaptor fabrication - 1/4 inch NPT(M) x 1/4 inch OD SS	2 sets
H.1.7	16 P x 0.5 sqmm cable for Teletel Drum level indication	500 Mtrs.
H.1.8	3c x 2.5 sqmm power cable Teletel Drum level indication	100 Mtrs.
H.1.9	9 Port lamp indication at control room and 9 port switching at Drum floor	1 set
H.1.10	Switchboards with switches	3 Nos.

NOTE TO BOQ:

1. The BOQ Ref. no given above may be linked with the BOQ Ref no in Price bid.
2. The Price bid contains the consolidated list of BOQ with brief description of items.
3. Rates are to be filled only in the Price bid.
4. Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document.
5. 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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VOLUME-IA PART –I CHAPTER -X GENERAL

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

- 1.10.1 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre-commissioning, commissioning and post-commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.
- 1.10.2 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.
- 1.10.3 It is not the intent to specify herein all details of material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.10.4 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.
- 1.10.5 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.
- 1.10.6 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.

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- 1.10.7 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.
- 1.10.8 During the course of erection, testing and commissioning C&I work certain rework / modification / rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and/ or units under erection and commissioning and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously and the same shall be deemed to be part of the scope of work.
- 1.10.9 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.
- 1.10.10 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.
- 1.10.11 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.
- 1.10.12 The scope of specification covers the installation, testing and commissioning of the erected equipment/ instrument along with accessories as detailed in Bill of Materials.
- 1.10.13 All the necessary certificates and licenses required to carry out this work are to be arranged by the contractor expeditiously at his cost.
- 1.10.14 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.
- 1.10.15 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.10.16 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.
- 1.10.17 After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.
- 1.10.18 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.
- 1.10.19 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.
- 1.10.20 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.
- 1.10.21 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.
- 1.10.22 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.
- 1.10.23 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.

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- 1.10.24 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.
- 1.10.25 Wherever erection sequences are furnished by BHEL, the contractor shall follow the same sequence.
- 1.10.26 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.
- 1.10.27 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.
- 1.10.28 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.
- 1.10.29 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.
- 1.10.30 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.
- 1.10.31 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.
- 1.10.32 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.33 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2000 Standards.
- 1.10.34 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 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 overall project schedule.
- 1.10.35 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
- 1.10.36 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.37 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.
- 1.10.38 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.
- 1.10.39 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.
- 1.10.40 All the equipments / material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.
- 1.10.41 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.
- 1.10.42 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.
- 1.10.43 **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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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 There shall be 3 separate Erection In-charges, each for Boiler, TG and Station C&I. They shall work independently with required manpower, T&P etc., including storage facilities. Each Erection In-charge shall have minimum 2 erection engineers with adequate Supervisors and Technicians

1.10.44.2 The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor. Besides

TECHNICAL CONDITIONS OF CONTRACT (TCC)

the above, there will be separate engineers for Planning, Safety and Quality. For all practical purposes, each of the above In-charges shall be provided with a PC and good communication facilities.

- 1.10.44.3 Resident Engineer should have a minimum qualification of Engineering Degree or Diploma in Engineering with 15 years of experience in Thermal Power Station.
- 1.10.44.4 Supervisor should have a minimum qualification of Diploma in Engineering or a graduate with 10 to 15 years of experience in Thermal Power Station.
- 1.10.44.5 Lab Technicians should have experience in Thermal Power Stations.
- 1.10.44.6 Contractor should have one Store Keeper and one Transport Supervisor for the safe transportation of materials.
- 1.10.44.7 Planning/safety Engineers should have experience in construction field especially in power plant

1.10.45 DOCUMENTATION

- 1.10.45.1 The following information shall be furnished after commencement of works.
 - a. Calibration certificates for the Instruments calibrated at site.
 - b. Test certificates of various tests conducted at site.
 - c. Erection and commissioning protocols signed by customer & BHEL
- 1.10.45.2 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.
- 1.10.45.3 VOLUME-IA PART- II CHAPTER -2 of this booklet contains general guidelines for Erection and Commissioning of C&I package

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PART –I CHAPTER -XI FOUNDATIONS AND GROUTING

- 1.11.1 Foundation for the equipments/panels/JBs/PBs to be erected shall be provided by BHEL/ clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments plants shall be carried out by the contractor.
- 1.11.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.
- 1.11.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 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 and supply of nuts, bolts, anchor fasteners 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 Minor civil works like drilling, chipping and punching holes on slabs and brick-walls and grouting related to installation of LIR/LIE/Local Gauge Board, control panels, Junction boxes etc., shall be included in the erection cost of such items. No separate payment is applicable. The scope also includes supply of grouting material. **More details regarding scope of civil are given in the respective equipment erection.**
- 1.11.11 PROCEDURE FOR GROUTING :
- Contractor has to carry out the grouting as per the work instructions for grouting available at site.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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

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

1.12.1 COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

- 1.12.1.1 BHEL shall issue materials covered in BHEL scope from their stores at site. The contractor shall collect such materials from BHEL stores and transport to his worksite at the contractor's cost.
- 1.12.1.2 The contractor shall inspect such materials as soon as received by the contractor and shall bring to the attention of the Engineer-in-Charge any shortage / damage or other defects noticed before taking over the materials. Materials once taken over will be deemed to have been received in good condition and in correct quantities except for intrinsic defects which cannot be observed by visual and dimensional inspection and weighing.
- 1.12.1.3 Upon receipt by the contractor the responsibility for any loss, damage and / or misuse of such materials shall rest with the contractor.
- 1.12.1.4 All materials issued by BHEL shall be properly stored and systematic records of receipts, issue and disposal will be maintained. Periodic inventory shall be made available to BHEL Engineer-in-Charge.
- 1.12.1.5 All materials issued by BHEL shall be utilized as directed by Engineer-in-Charge or most economically in the absence of such direction. The contractor shall be responsible for the return to BHEL Stores of all surplus material, as determined by the Engineer-in-Charge.
- 1.12.1.6 If the materials issued by BHEL are lost, damaged or unaccounted, the cost of such items shall be recovered from payments to the contractor. However, the contractor shall raise FIR and inform BHEL all details.

1.12.2 STORAGE

- 1.12.2.1 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.
- 1.12.2.2 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.
- 1.12.2.3 Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolorisation takes place or regenerated. BHEL shall supply the material and contractor shall replace.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.12.2.4 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.
- 1.12.2.5 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.
- 1.12.2.6 Contractor shall keep BHEL informed about such problem and try to rectify the problem at his risk and cost.
- 1.12.2.7 All the instrument, 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.
- 1.12.2.8 Packing material shall be retained if the cubicle to be repacked after inspection
- 1.12.2.9 All sub-assemblies should be kept in a separate place where it is easily accessible.
- 1.12.2.10 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. Sub-assemblies should not be stacked one above the other.
- 1.12.2.11 The loose items supplied for the main equipment falls into various categories like tools, modules, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, PCs, monitors, cable glands, cable ducts, frames etc. are to be categorised and stored separately.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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

1.13.0 DETAILED SCOPE OF C&I WORK

The scope of work for C&I items like Instruments, Panels, Hardware etc. covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing, loop checking & commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, ferrules, lugs (specific sizes), specific types of fasteners, paints and consumables. Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (excepting proprietary type instruments), returning of un-used materials / items to stores are also covered in the scope of work.

1.13.1 SCOPE OF WORK FOR C&I PANELS / CONTROL DESK:

- 1.13.1.1 The different types of Microprocessor based panels like PLC/DCS Panels, Instrument Panels, unit control desk etc. are covered in the scope of work for erection and commissioning.
- 1.13.1.2 The unit rate quoted for Installation of control panels shall include fixing of anti-vibration pads, levelling and alignment, welding, grouting, drilling of bottom gland plates for cable entry as required, closing control panels bottoms with suitable flame proof compounds wherever required and checking of internal wiring, instruments, components etc. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels except the Instruments identified in the BOQ.
- 1.13.1.3 Panels are normally supplied in suite of one / two / three/ four cubicles with bottom base frame and these panels are to be mounted on separate site fabricated base frames as per site condition. The base frames to be properly grouted to the concrete floor or to be TIG welded to the embedded insert plates. The structural steel material for the above will be supplied by BHEL. For fabrication and erection of frame, unit rate shall be paid on tonnage basis.
- 1.13.1.4 For panels to be mounted on trenches, if any channel supports are required, the same shall be provided across the cable trenches over which the base frames of the panels shall be mounted. Similarly for the panels to be mounted on false flooring, if mounting frames are not provided, same shall be fabricated at site. The contractor shall carry out fabrication and erection of these support structures on tonnage rate basis.
- 1.13.1.5 The panels which are supplied for various control systems have to be erected at different places like unit control room/ near the equipment/

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- various operating floors as per site 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.
- 1.13.1.6 If any minor grinding is to be carried out on the cut-outs provided in the panels for mounting instruments like recorders, indicators, console etc., the same shall be carried out by the contractor at no extra cost.
- 1.13.1.7 All the panels and JBs shall be electrically earthed to the nearest earth grid by means of GI wire/Flats as per the instructions of BHEL engineer.
- 1.13.1.8 Painting of fabricated parts and earthing conductors of panels shall be part of the work. Touch up painting for panels, including supply of paints shall be carried out by the contractor within the quoted rate.
- 1.13.1.9 Closing the Panel openings and unused drilled holes with non-flammable sealant materials, including supply of above material, shall be part of erection work.
- 1.13.1.10 For panels/ equipment erected by other agencies, commissioning work and troubleshooting are to be carried out by the contractor as per the rate quoted in the schedule.
- 1.13.1.11 Normally the panels shall be supplied with instruments / modules mounted and wired. No separate payment shall be made for commissioning of any instrument/ cards/ components. If dismantling of the above such instruments and rewiring is needed at site, the same shall be carried out at no extra cost. If any instruments/ cards/ components supplied as loose items for safe transit, the same shall be mounted and wired at no extra cost unless specified otherwise in the BOM. Similarly, if any loose supplied instruments /modules are to be mounted and wired on customer panels or any other panels not erected by contractor, the same shall be carried out at no extra cost unless otherwise specified in the BOM. However, if any major installation/modification/wiring are involved, the same may be carried out as extra work. The decision of BHEL Engineer shall be final in respect of above extra works.
- 1.13.1.12 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 within + 20% of length shall not be considered for payment. However, for variations beyond + 20% in length, price adjustment shall be considered proportional to the length of the panel.
- 1.13.1.13 UPS, AC & DC DB AND OTHER ELECTRICAL CONTROL PANELS

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1.13.1.14 The erection & commissioning scope of above panels will be in line with clauses above in 1.13.1.

1.13.2 SCOPE OF WORK OF DCS PACKAGE / PADO SYSTEM WITH RELATED INSTRUMENTATION:

1.13.2.1 BHEL will supply sophisticated MAX-DNA DCS system / PADO System. The tentative details of are furnished in the BOM.

1.13.2.2 The scope of DCS system includes erection of sophisticated microprocessor based systems, max DNA control panels, I/O panels, Ethernet switching panels, Network Enclosure cabinets, CPU, Engineers workstations, operator workstations, CRTs, server, printers, portable UPS power supply, furniture and interconnecting cables like Ethernet/Fibre-optic etc.

1.13.2.3 The scope of work for DCS Panels will generally be in line with that for C&I Panels as detailed in Clause 1.13.1

1.13.2.4 Unit rate quoted for DCS equipment shall cover installation & integration of all the above said equipment and providing necessary commissioning assistance. No separate unit rate applicable for installation of loose items/ modules/ components or accessories including furniture etc, which is not explicitly mentioned in the BOQ, but comes as part of the system.

1.13.2.5 Separate rate shall be applicable for laying and termination of cables including fibre optic/ Ethernet as detailed in the scope of work for cabling. Termination of fibre optic cables is excluded from the scope of this contract.

1.13.3 SCOPE OF WORK FOR UPS, BATTERY AND BATTERY CHARGER

The charger and batteries are of heavy duty type. Charger batteries are capable of providing 24 V DC Supply for DCS Systems. The cells will be mounted on insulators carried on suitable wooden / fibre stands. Tentative details are given in the BOM.

BHEL will provide vendor's technical support for commissioning of Battery and Battery charger. The contractor shall carry out the works as per instructions of BHEL/ Vendor Engineer.

Lumpsum shall be quoted for Erection and commissioning of UPS and Battery. No additional payment shall be made for any variation in the number of cells. The unit rate quoted for erection of UPS and battery will include the following works.

1.13.3.1 Filling the individual cells with Acid/alkali – if applicable.

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- 1.13.3.2 Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.
- 1.13.3.3 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.
- 1.13.3.4 Modifications or changes if any for the loose supplied items or any minor changes in wiring.
- 1.13.3.5 Arranging necessary tools, T&P, Testing equipments required for erection and commissioning of the battery.
- 1.13.3.6 For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.
- 1.13.3.7 **SCOPE OF WORK FOR BATTERY CHARGER PANELS**
The scope of work will be in line with scope of work for control panels, as detailed under Clause above in 1.13.1.
- 1.13.4 SCOPE OF WORK FOR INSTRUMENTS:**
- 1.13.4.1 The type of instruments to be erected and commissioned shall be as detailed below:
 - 1.13.4.1.1 All types of transmitters like temperature, pressure, flow, level and position feedback transmitters etc.
 - 1.13.4.1.2 Local mounted pressure gauges, DP gauges, thermocouples, RTDs, temperature gauges, temperature switches, pressure switches, DP switches, flow switches and limit switches and flow indicator level switches etc.
 - 1.13.4.1.3 Air filter regulator sets, Air lock off valve, Power cylinders etc.
 - 1.13.4.1.4 Panel/ Control desk mounted Instruments like indicators, recorder, console and electronic modules etc.
 - 1.13.4.1.5 I/P converters and local controllers.
 - 1.13.4.1.6 Special instruments like vibration sensors, proximity sensors, electronic water level indicator, SWAS, Gas analyser, Coal Flow Monitor, PC based instruments etc.
 - 1.13.4.1.7 Pneumatic operated control valves, trip valves, solenoid valves, and electrically operated valves. (commissioning only)
- 1.13.4.2 Prior to installation, all the Instruments (local & remote), I/P converters, etc. shall be calibrated. Similarly, the healthiness of RTDs and thermocouples, limit

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switches, flow switches, level switches, solenoid valves, air filter regulator, purge meters, etc. shall be checked for proper operation.

- 1.13.4.3 Unit rate quoted for each instrument shall include calibration, installation, loop checking, commissioning and troubleshooting until satisfactory performance as per operational and system requirement and maintenance till the end of contract period or trial operation whichever is earlier. In case any instrument requires recalibration to achieve the expected performance, the same shall be carried out at no extra cost. If any re-calibration or replacement of instruments and rechecking of cable termination is found necessary during commissioning, the same shall be done at no extra cost. The unit rate shall also cover marking Tag numbers of instruments or Racks, either by paint or a separate tag plate as per BHEL Engineer's directive.
- 1.13.4.4 Unit rates have been asked item-wise for instruments, gauges, switches, indicators, recorders etc. as indicated in BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items of work of the rate schedule.
- 1.13.4.5 If any instrument is to be relocated for reasons not attributable to the contractor, but required for satisfactory performance, the same shall be carried out on extra works basis.
- 1.13.4.6 Unit rate quoted for erection of pressure/ differential pressure transmitters, gauges, switches, shall include fixing the instruments on the racks / supports along with manifolds, and associated fittings and clamps.
- 1.13.4.7 Unit rate quoted for Temperature transmitters, I/P converters, Air filter/ Air lock off valves, Purge meters, Rotameters, position transmitter, probes etc shall include fixing the instruments on the racks / supports along with associated fittings and clamps.
- 1.13.4.8 Unit rate quoted for control room mounted instruments shall cover mounting of instruments on panels / desk wiring, minor grinding on the cut out of panels for proper fixing.
- 1.13.4.9 Unit rate quoted for erection of Casing temperature thermocouple of turbine/ metal temperature thermocouple (MTM) shall cover laying, dressing and clamping, supply and fixing of tag plates, etc. Welding of MTM pads shall be carried out by mechanical contractor. Necessary tray supports for routing of MTM thermocouples shall be erected as part of tray erection covered in the tender. Proper care shall be taken during cleaning the crevices where MTM Thermocouples are inserted.
- 1.13.4.10 Unit rate quoted for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells, seal welding of thermowell, wherever required as per BHEL specification and directive of site engineers.

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- 1.13.4.11 Unit rate quoted for erection and checking of temperature switches, gauges, thermocouple, RTD etc. shall include cleaning of thermowell stubs threads using tap sets, fixing of thermowells, seal welding of thermowell, wherever required as per BHEL specification and directive of site engineers.
- 1.13.4.12 Unit rate quoted for erection and commissioning of float type Level switches includes fixing of switches on float chambers and fixing of float chambers on stand pipe, providing supports wherever required, any minor modification required to match Float chamber with tapping point etc.
- 1.13.4.13 The unit rate quoted for erection and commissioning of Electronic type Level switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, any minor modification required to match Float chamber/ Electrode standpipe with tapping point, integration of all loose supplied items etc.
- 1.13.4.14 Unit rate quoted for erection/commissioning of special instruments like, Flame scanner, H.E.A Igniters systems, Vibration monitoring System, Electronic water level indicator, Sonic Tube Leak Detection system, SWAS, Gas analyser, PC based instruments, Coal Flow Monitor, Bunker level monitor, etc. shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, integration of total system and commissioning. Lump sum rate shall be quoted as mentioned in the BOQ. No separate rate shall be payable for loose items including furniture. The quantity of loose supplied items is approximate only. No proportional rate will be applicable for any variation in quantity or for any additional items supplied as part of equipments.
- 1.13.4.15 If any surface finishing / tapping is required to fix the sensors for Vibration Monitoring System, the same shall be arranged by the contractor at no extra cost.
- 1.13.4.16 Some of the Gas Analysers are to be installed at Chimney 71 ML as indicated in BOQ. For the erection of associated hardware for these analysers, like cables, trays, GI pipe etc. that are to be routed from the analyser panels at 71 ML of Chimney to zero meter level, payment will be made at twice the unit rate quoted against each item.
- 1.13.4.17 For Coal Bunker level monitor, fixing / erection of the sensors onto legs of Bunkers is in the scope of Vendor and arranged by BHEL. However, the contractor shall provide necessary approach platforms with ladders and any other assistance for erection of these sensors.
- 1.13.4.18 All instruments are generally covered in rate schedule. However, if any instruments not covered, but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent unit rate for those instruments shall be considered wherever possible from the BOQ.

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- 1.13.4.19 Canopy shall be provided for field-mounted instruments as per site requirements. Necessary materials like MS Plate shall be provided by BHEL. Rate for fabrication and installation of canopy shall be on tonnage basis.
- 1.13.4.20 Temporary protection by thermocol, polythene sheet, GI sheets shall be provided by the contractor for safe guarding the instruments against damages. The protective materials shall be supplied by the contractor at no extra cost.
- 1.13.4.21 In case the Instruments are mounted and supplied along with main equipment and the BOQ calls for Erection & Commissioning, the contractor shall carry out removal, calibration, re-fixing and commissioning of same. Payment shall be made only for removal, calibration, re-fixing and commissioning, in line with rate quoted for removal, calibration and re-fixing of Instrument of similar type.
- 1.13.4.22 In case the Instruments are supplied as loose items, and the BOQ calls for removal, calibration, re-fixing and commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made only for Erection and commissioning in line with rate quoted for Erection and Commissioning of Instruments of similar type.
- 1.13.4.23 The scope of work for panels for TSS System, Sonic Tube Leak Detection System, Furnace Flame Viewing System, Master Clock System etc. will be in line with the scope of work of C&I panels covered under clause above in 1.13.1
- 1.13.5 SCOPE OF WORK FOR IMPULSE PIPES:**
- 1.13.5.1 Different types of impulse pipes, like alloy steel, carbon steel, stainless steel of different sizes and thickness shall be supplied with suitable fittings like coupling, sockets, root valves, drain valves, manifold, condensing pots, syphons, tees, bends, nut and tail piece.
- 1.13.5.2 Unit rate quoted for impulse piping shall include site routing using reducers (at root valve) unions, connector Nuts and tail pieces, sockets, nipples, equal tees, couplings, condensing pots, siphons, root valves, isolation valves cold bending, tig / arc welding. etc., fixing of manifolds and supporting with suitable fixtures and 'U' clamps and painting as per BHEL specification and site engineer's instructions. No separate rate shall be paid for the Impulse pipe fittings. The unit rate also includes supply of U clamps, fasteners, paints, etc. For impulse pipe support materials viz. Angles/ Channels, the rate shall be paid on tonnage basis. The above support materials shall be supplied by BHEL. For scope of painting, please refer Scope of Painting clause. Welding of impulse pipe for High Pressure Lines shall be carried out by High Pressure welder. Suitable root valves will be provided by BHEL on the tapping point wherever required
- 1.13.5.3 TIG-welding sets, welding transformer/generator rectifier, Hydraulic bending machines, DPT kits, Hydraulic testing pumps required for pressure testing of impulse pipes shall be arranged by the contractor. Similarly, consumables

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such as welding electrodes, gas, Tungsten rods, filler wire etc., shall be arranged by the contractor within the quoted rate.

- 1.13.5.4 For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer.
- 1.13.5.5 Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, as part of the work.
- 1.13.5.6 The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.
- 1.13.5.7 Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.

1.13.6 SCOPE OF WORK FOR PRE-FABRICATED/ SEMI-FABRICATED LIR/ LIE/ GAUGE BOARDS

- 1.13.6.1 If the frame or rack is supplied as a pre-fabricated item like LIR, same shall be erected, grouted and painted as per site requirement.
- 1.13.6.2 If any frame or support or rack supplied as semi fabricated item, same shall be assembled at site either by welding or bolting and erected, grouted and painted as per site requirement.
- 1.13.6.3 Unit rate quoted for such pre-fabricated /semi fabricated items like LIE/LIR and enclosure shall be on Number basis. Unit rate shall cover installation, grouting, painting and supply of nuts, bolts, anchor fasteners, grouting materials such as cement, sand etc as required. Unit rate shall also include full painting of impulse line fitted and supplied along with LIR/LIE/LGB.
- 1.13.6.4 Wherever LIR/LGB/LIE are supplied with instruments mounted on them, the rate quoted for LIR/LGB/LIE shall include calibration of all the instruments mounted on them as detailed in the BOQ. However if the instruments supplied as loose items, the instruments shall be calibrated and mounted on the LIR/LGB/LIE and separate calibration/erection /commissioning charges shall be applicable in line with other instruments erection.

1.13.7 SCOPE OF WORK FOR COPPER/SS TUBES:

- 1.13.7.1 Different sizes of copper tubes of different thickness with or without PVC coating shall be supplied in standard lengths of 15 Mtr Coils and SS tube shall be supplied in standard length of 6 meter. The connectors and tees will be of brass/SS of different sizes as per site requirement.
- 1.13.7.2 The unit rate quoted on meter basis shall cover site routing, bending, providing supports, fixing of connectors, unions, valves, tees, etc. and connecting to the instrument air line instruments. The unit rate shall also include providing tag plates on instruments / power cylinders.
- 1.13.7.3 If copper/SS tube length is more than ½ mtr, suitable support shall be provided either by angle or trays. Protective angles to be used for copper

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tube routing. The support materials shall be supplied by BHEL. Separate Rate shall be paid for fabrication and erection of supports as per rate quoted in the BOQ.

- 1.13.7.4 Copper/SS tubes shall be clamped with suitable clamping materials. Supply of suitable Aluminium clamps and tag plates are under contractor's scope. The unit rate quoted for laying of copper tube shall cover the supply of clamping materials also. For SADC system copper tube Tag plate shall be provided near instruments, Tees and Power cylinders. Leak test shall be carried out after completion of tubing works as per guidelines.

1.13.8 SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):

- 1.13.8.1 Different type of GI pipes of different thickness class shall be supplied along with GI fitting accessories like union, coupling, tee, reducers, elbow, valves, etc.

- 1.13.8.2 Unit rates on length basis for erection of instrument air lines includes site routing, providing supports, fixing "U" clamps, fixing of loose supplied GI accessories mentioned as above as per the drawings, providing fresh threading as required for jointing with unions, valves and all type of other fittings as required in the system. Unit rate also shall include supply of U clamps, Teflon tapes and bolts, etc.

- 1.13.8.3 Teflon tapes shall be used for tightening all the joints. No bending, welding etc. is allowed. No separate rate shall be paid for erection of GI fittings / accessories and U clamps.

- 1.13.8.4 After installation of instrument airlines, the line shall be blown and leak test shall be conducted for all the joints as per the guidelines given elsewhere in this tender.

1.13.9 SCOPE OF WORK OF ELECTRIC & PNEUMATIC ACTUATORS:

- 1.13.9.1 Different types of pneumatic actuators like regulating type, on-off type, of different stroke length shall be supplied. Some of them may be fitted and supplied with main equipment.

- 1.13.9.2 The unit rate quoted for erection & commissioning scope of electrical and pneumatic actuators includes fabrication and installation of base frame, modification of linkage mechanism wherever required and connecting the same with driven equipment, fixing of all accessories like air sets, Solenoid valves, air lock off valves, limit switches, if supplied loose item as part of power cylinders, replacing the damaged copper tubes or any other accessories like gauges, solenoid valves, limit switches, etc. connecting to air line, and adjusting the stroke length. No separate rate shall be paid for the above works. For all pneumatic and electrical actuators, the necessary Linkage Mechanism shall be supplied by BHEL as part of actuators. No separate rate shall be paid for erection of linkage mechanism. For fabrication

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and erection of steel supports and frames, the rate shall be paid on Tonnage basis.

- 1.13.9.3 The link rods have to be adjusted to suit the opening and closing position. This adjustment has to be repeated number of times till proper operation is obtained. If BHEL site engineer desires to remove the accessories like position transmitters, air locks, positioners, limit switches, solenoids etc. prior to erection either at BHEL stores or at site to avoid damages/pilferage, keep in safe custody and remount the same prior to commissioning, this shall be part of scope of work for power cylinders.
- 1.13.9.4 For calibration of any Pneumatic Actuator at field, temporary air supply if required shall be arranged by the contractor.
- 1.13.9.5 In case the power cylinder is supplied in assembled condition along with main equipment and the BOQ calls for Erection & Commissioning of the same, payment shall be made only for commissioning, in line with rate quoted for commissioning of pneumatic power cylinder of similar type.
- 1.13.9.6 In case the power cylinder is supplied as loose item, and the BOQ calls only for commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made in line with rate quoted for Erection and Commissioning of power cylinder of similar type.
- 1.13.9.7 Erection and Commissioning of MCCs and laying of power cables to bi-directional electrical actuators shall be done by other agency. The C&I Contractor shall provide necessary support for checking the remote operation of Electric actuators and loop checking of command and feedback signals from DCS to the actuator. The Contractor shall co-ordinate with the other agencies to ensure that all feedback and command signals and settings are made available for bi-directional actuators, at no extra cost.
- 1.13.10 SCOPE OF WORK FOR CABLES:**
- 1.13.10.1 BHEL will supply LT, 1.1 KV, armoured/ unarmoured, Copper PVC FRLS insulation, Power, Control and Instrumentation cables of different sizes. The special cables supplied shall be Compensating cable, Ethernet cables and Fibre-optic cable of different sizes and type.
- 1.13.10.2 The scope of work includes laying & termination of cables, fixing of glands, ferrules, tag plates with necessary numbering and dressing of cable, as per BHEL specification and BHEL engineer's instructions. A composite rate covering laying and termination shall be applicable for cables, except for higher size cables. Separate rate will be applicable for termination of higher size cables, and the same will be indicated specifically in the Rate Schedule.
- 1.13.10.3 Unit rate quoted for cable shall cover laying, termination, 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.

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- 1.13.10.4 Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed elsewhere in this tender.
- 1.13.10.5 Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.
- 1.13.10.6 Ethernet cables and Fibre optic cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer. Wherever required I/O Box shall be installed for Ethernet cable termination and Punch Down crimping tools shall be used for Ethernet cable termination.
- 1.13.10.7 The scope of work for Fibre Optic cable shall be laying only. Termination of Fibre optic cables shall be carried out by the cable vendor and the contractor shall provide necessary assistance to the vendor during cable termination. Wherever required, the Fibre optic cable shall be laid through HDPE Conduit. Unit rate quoted for laying of Fibre Optic cable shall include laying of HDPE conduit wherever required.
- 1.13.10.8 The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. No separate rate shall be paid for cable terminations. For cable joining, if any, separate rate shall be considered on extra works basis.
- 1.13.10.9 The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.
- 1.13.10.10 Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.
- 1.13.10.11 During testing and commissioning, if the equipment on which the cables are terminated (including electrical drives) is not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling. The contractor shall promptly depute his supervisor or technicians to assist the commissioning agencies to check the interconnecting cables at no extra cost.
- 1.13.10.12 Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.
- 1.13.10.13 If the cables are to be laid on the angles or routed in conduit pipe as per site condition, the unit rate for erection of angles and conduit pipes shall be as per the rate quoted elsewhere in the tender.
- 1.13.10.14 Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.

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- 1.13.10.15 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services any such adjustment shall be done with the approval of Engineer.
- 1.13.10.16 The approximate number of termination for the purpose of estimation to be assumed as follows: The average RUN length shall be considered as 150 Mtrs. However, for 10% of the 2 pair and below, the average length shall be considered as 30 Mtrs.
- 1.13.10.17 The cables covered in the BOQ may be appearing either in C&I cable schedule or in Electrical cable schedule. The contractor shall lay and terminate all the cables covered in the BOQ, as per directive of BHEL Engineers.
- 1.13.10.18 SCOPE OF CABLE TERMINATION
- 1.13.10.18.1 The scope of termination shall include termination of cables on various equipment installed by others.
- 1.13.10.18.2 Re-termination, if required during testing/ commissioning shall be carried out without additional cost.
- 1.13.10.18.3 Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant, long enough to over pass conductor insulation and properly sized.
- 1.13.10.18.4 Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.
- 1.13.10.18.5 Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.
- 1.13.10.18.6 After cable terminations, the debris shall be removed then & there.

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1.13.11 SCOPE OF WORK FOR CABLE TRAYS/ CONDUITS/ FLEXIBLE CONDUITS/ HOSE:

1.13.11.1 A-CABLE TRAYS

Scope of cable tray works covers erection of various sizes of perforated trays with accessories mostly for branch trays in Power House building. All type of cable trays including, standard trays accessories shall be supplied by BHEL.

The scope of work for cable trays shall be as follows:

- a. Different Junction The unit rate for erection of trays shall be on meter basis. The unit rate quoted for erection of tray shall also include erection of all tray accessories such as elbow, cross, Tees, bends such as vertical and Horizontal, reducers, coupler plates/fixing plates, anchor bolts, fasteners etc.
- b. For routing of trays standard tray accessories supplied by BHEL shall be used. However if above standard tray accessories are not supplied, the same shall be fabricated and installed at no extra cost.
- c. If standard tray accessories like Tees, Reducers, Bends, cross etc. require any modification to suit the tray routing, the same shall be carried out at no extra cost.
- d. The unit rate quoted for trays shall also cover making of offsets by means of cutting standard tray sections and inserting suitable trays to match with the existing arrangement.
- e. No separate rate shall be paid for any such site fabrication/ modification on trays or on tray accessories.
- f. The contractor shall quote a uniform rate on meter basis for erection of trays and Tray accessories like Tees, Reducers, Bends, cross etc.
- g. Tray covers are to 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 trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.

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1.13.11.2 B- 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 supplied by BHEL shall be used. Unit rate shall be paid on running meter basis.
- b. Unit quoted on meter basis 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. No separate payment will be made for fixing of end connectors.
- c. Unit quoted on meter basis for GI rigid conduit includes supply of suitable clamps/ fasteners/ tag plates etc.

1.13.12 SCOPE OF WORK FOR JUNCTION BOXES/CJCBs /PUSH BUTTON BOXES:

1.13.12.1 Boxes/ Push Button boxes with gland plates shall be supplied by BHEL.

1.13.12.2 The unit rate quoted for erection of junction boxes/push button boxes shall cover the following also.

- Providing necessary supports
- Drilling of bottom gland plates for cable glands as required
- Painting the tag Nos. or fixing a separate tag plate on junction boxes/push button boxes
- Minor chipping, grouting as required for mounting the JB/PB
- Supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button.
- Closing all unused holes on the gland plates using grommet or any other suitable materials.
- Any modification like replacement of terminals, enlarging gland holes etc. that may be required to accommodate power cables.

1.13.12.3 All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.

1.13.12.4 For CJCBs/ RJCBs, the rate for Junction Boxes similar size, as per Rate Schedule, will be applicable.

1.13.12.5 For fabrication and fixing of supports/Frame, rate shall be paid on tonnage basis.

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1.13.13 SCOPE OF WORK FOR FABRICATION & ERECTION OF STEEL MATERIALS:

- 1.13.13.1 Scope of steel fabrication and installation covers, fabrication and installation of various type of supports for cable tray, instruments, impulse pipes, GI pipes, support angles for copper tubing, mounting frames for JB, Control Box/Panel, local PB Stations, canopy for local instruments and local instrument rack etc. wherever required.
- 1.13.13.2 The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL. Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.
- 1.13.13.3 Immediately after fabrication, primer shall be applied to prevent corrosion. The installation shall be carried out only after applying the primer as detailed in painting clause.
- 1.13.13.4 All fabricated steel materials shall be painted as detailed in the scope of painting.
- 1.13.13.5 A composite rate shall be quoted for fabrication and installation of steel, on tonnage basis. The above rate shall include supply of paints and painting, grouting and grouting material as required.

1.13.14 SCOPE OF EARTHING

- 1.13.14.1 The scope of earthing covered in this contract is above ground earthing i.e equipment earthing. Scope of earthing covers earthing of field Instruments, JBs, Branch trays, LIR/LIE, JB, Push Button boxes etc. All DCS and its accessories, PLC/Instrumentation panels/systems etc, shall be earthed to a separate Electronic earth grid.
- 1.13.14.2 Different type of earthing materials shall be supplied and same shall be erected as per site requirement.
- 1.13.14.3 The scope of work shall include supply of fasteners, lugs, minor civil works etc.
- 1.13.14.4 All connections from the equipment to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the contractor at site.

1.13.15 SCOPE OF CALIBRATION:

- 1.13.15.1 Contractor shall calibrate all the instruments (Gauges, Transmitters and Switches), panel mounted instruments including that will be supplied along with equipments mounted in or as loose.
- 1.13.15.2 Contractor shall calibration records as per the format CP:PEX:FOX enclosed elsewhere in this tender specification.
- 1.13.15.3 All testing Instruments/ Equipment deployed for calibration shall be calibrated before taking it into service. A copy of calibration certificate issued by

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recognized/accredited agencies shall be submitted to BHEL Engineer for his verification and approval.

- 1.13.15.4 BHEL will provide vendor support for calibration of proprietary instruments such as analysers etc. If BHEL is unable provide or arrange vendor support for above mentioned proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by outside 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 rate. However overall responsibility lies with contractor and Contractor shall provide all supports like manpower, standard T&P, Instruments etc for calibration and testing of above proprietary type instruments
- 1.13.15.5 The contractor shall carry out calibration with their own calibration and testing equipments and shall be done under the supervision of BHEL/Customer Engineers.

1.13.16 MEASUREMENTS & WASTAGE & CUTTING ALLOWANCES:

- 1.13.16.1 For all payment purposes, measurement shall be made on the basis of the execution of drawings/physical measurements. Physical measurements shall be made by the contractor in the presence of the Engineer.
- 1.13.16.2 The measurement for cable, impulse pipes/tubes, GI pipe, conduits, flexible conduits, trays etc. shall be made on the basis of length actually laid.
- 1.13.16.3 All the surplus, scrap and serviceable materials, out of the quantity issued to the contractor shall be returned to BHEL in good condition and as directed by the engineer.
- 1.13.16.4 All materials returned to stores should carry an aluminium tag indicating the size and type. More than 5 metres length termed as serviceable material and shall be returned size wise and category wise to the owner's stores/yard. Cable of serviceable length being returned to the stores in drums shall have their free ends sealed and the balance lengths on the drum(s) shall be noted and certified by the Engineer-in-charge. This shall be applicable only for the purpose of accounting the cables issued for installation.
- 1.13.16.5 While carrying out material reconciliation with contractor, all the above points will be taken into account. All serviceable material returned by the contractor shall be deducted from the quantities issued for the respective sizes and categories and the balance quantity(ies) will be taken as the net quantity(ies) issued to the contractor. Material appropriation shall be done and allowable scrap quantity calculated as per wastage allowance specified in Part II. Any scrap/wastage generated by the contractor in excess of the allowable percentage shall be charged at the rates decided by the Engineer whose decision shall be final and binding on the contractor.

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- 1.13.16.6 For all site-fabricated steel items such as supports, racks, frames, Canopy etc. physical measurement shall be made and then converted to tonnage. For steel material supplied to the contractor, all scrap shall be returned to BHEL stores with due accounting.
- 1.13.16.7 Every month the contractor shall submit an account for all the materials issued to him by BHEL in the standard proforma prescribed for this purpose by the site in charge.
- 1.13.16.8 The erection contractor shall make every effort to minimize wastage during erection work. In any case, the wastage shall not exceed the following limits;
- | S.No. | Item | % Wastage on issued Qty |
|-------|-----------------------------------------|-------------------------|
| 1. | Fabrication steel | 2 |
| 2. | Each size of power cables | 1 |
| 3. | Each size of control/Inst cables | 2 |
| 5. | Impulse pipe/tubes/GI pipes/copper tube | 1 |
- 1.13.16.9 If however, the bidder quotes for more wastage than specified above, the excess portion will be considered for adjustment during the tender evaluation at the quoted supply rate of material.
- 1.13.16.10 The cable take off from drums shall be planned strategically such that jointing in the run of cables and wastage are avoided. For this purpose the exact route length between various equipment/panels as per the cable schedule shall be measured and the route length recorded before laying of the cables. Depending upon the route length the type of cable required for various destinations, the cable drums shall be suitably selected for cable laying. Any jointing which may be approved by the engineer all the cut pieces/bits of cables which are not used/unused shall be returned to the purchaser for accounting towards wastage. The cables damaged by the contractor shall have to be replaced by the contractor at his own cost.

NOTE:

Salvageable scrap shall mean lengths of pipes, multicables, other cables etc., that can be used one time or other at a later date and normally they are recovered from the cut-pieces of tubes, pipes, multicore cables, cables etc.

Non - Salvageable scrap means the lengths of tubes, pipes, multicore cables, cables etc., and they are from cut-pieces of tubes, pipes, multicore cables, cables etc., that cannot be used at all one time or other.

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BHEL PS:SR Format
No. **CP: PEX:FOX**

CALIBRATION RECORD OF SUB-CONTRACTOR'S INSTRUMENTS

Name of Site :

Name of Sub-contractor :

Sl.No	NAME OF INSTRUMENT	INSTRUMENT REGN. NO.	DATE OF	PERIODICITY OF CALIBRATION	CALIBRATION DETAILS
			ENTRY EXIT		
					DATE OF CAL. CAL. AGENCY NEXT DUE DATE DATE OF CAL. CAL. AGENCY NEXT DUE DATE DATE OF CAL. CAL. AGENCY NEXT DUE DATE

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

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

- e) Consumables report giving consumption of all types of gases and electrodes during the previous month.
 - f) Availability report of cranes
 - g) Safety implementation report in the format
 - h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.
- 1.14.7 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.(format enclosed below for reference)
- 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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MONTHWISE MANPOWER DEPLOYMENT (NUMBER TO BE INDICATED CATEGORYWISE IN EACH MONTH) BY THE CONTRACTOR

S.NO	CATEGORY	MONTHS									
		1	2	3	4	5	6	7	8	AND SO ON	
01	Resident Manager										
02	Engineers for Boiler/TG Engineers for Planning/ Safety										
03	Supervisors a. Impulse line b. cabling/tray c. panels d.calibration/instalation										
04	Riggers										
05	Fitters										
06	HP Welders										
07	Structure Welders										
08	TIG welders										
09	Electricians										
10	Store Keeper										
11	Semi skilled and unskilled workers										
12	Watchman/Security										

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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 The scope of commissioning works covers commissioning of all instruments covered in the BOQ including loop checking and establishing the operation of instruments /systems to meet plant commissioning/operation. The contractor shall be responsible for overall commissioning of all the instruments and systems covered in the BOQ.
- 1.15.2 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/Chemical Cleaning.
 - d) Turbine barring gear.
 - e) Steam blowing of piping.
 - f) Turbine rolling.
 - g) Safety valve floating.
 - h) First synchronization
 - i) Trial Operation / Full load.
- 1.15.3 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.
- 1.15.4 The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.
- 1.15.5 The precommissioning activities of the main power plant will start with run of various equipments prior to light up of boiler and commissioning operations shall continue till the unit is handed over to customer. The contractor shall simultaneously start commissioning activities for the equipment erected to match with the various milestone activities of commissioning programme of the project.
- 1.15.6 Contractor shall arrange experienced commissioning engineers, supervisors including electricians/instrument mechanics in each area to be associated with BHEL commissioning staff. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted. It shall be specifically noted that above employees of the contractor may

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have to work round the clock along with BHEL commissioning engineers involving considerable payment of overtime, which forms part of Contractor's Scope.

- 1.15.7 The mobilization of these commissioning groups shall be such that planned activities are taken up in time and also completed as per schedule and the work undertaken round the clock if required. It is the responsibility of contractor to discuss on day to day / weekly / monthly basis the requirement of 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 necessary recoveries with overhead cost will be made from the bills of the contractor.
- 1.15.8 After erection of various equipment prior to commissioning and after commissioning, protocols have to be made with BHEL's customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers.
- 1.15.9 For electrical works, 415 volts and above, the contractor has to bring qualified electricians and the total work has to be certified by electrical license holder. The expenditures towards work certificate and all statutory requirements connected towards the high voltage system shall be borne by the contractor.
- 1.15.10 In case any rework/repair/rectification/modification/fabrication etc. is required 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. If 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. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.
- 1.15.11 During commissioning activities and carrying out various tests, if any of the instruments has to be temporarily erected and commissioned to suit the commissioning activities, the contractor have to carry out the erection of the same. After completion of activities the temporary systems have to be removed and returned to stores and no extra rate shall be paid for this.
- 1.15.12 All the T&P instruments required for commissioning are to be arranged by the contractor. However, any special instruments, which are of proprietary nature, shall be arranged by BHEL.
- 1.15.13 It shall be the responsibility of the contractor to arrange and complete all the testing, pre-commissioning and commissioning activities for the particular equipment as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. All the above will be witnessed by the BHEL engineers and reports signed shortly. Contractor shall follow checklist of BHEL and testing & commissioning activities shall be carried out in accordance with the checklist.
- 1.15.14 The scope of commissioning shall also cover the commissioning of the equipment/drives erected by the mechanical contractors. (as detailed in the BOQ)

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- 1.15.15 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.
- 1.15.16 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
- 1.15.17 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.
- 1.15.18 Commissioning Engineers also shall be identified separately for each package and the minimum requirement shall be as indicated below (Requirement given below is per unit).

	Boiler	TG	Station C&I	TOTAL
Engineer (C&I)	1 No.	1 No.	2 Nos.	4 Nos.
Supervisor (C&I)	3 Nos.	3 Nos.	4 Nos.	10 Nos.
Technician (C&I/ Elec)	6 Nos.	6 Nos.	10 Nos.	22 Nos.

- 1.15.19 The above commissioning group shall be identified at the Pre-commissioning and commissioning time. The above commissioning group shall have knowledge of various systems referred in the tender and also should have adequate experience.
- 1.15.20 The above manpower is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor. Besides the above, there will be separate engineers for Planning, Safety and Quality. For all practical purposes, each of the above In-charges shall be provided with a PC and good communication facilities.
- 1.15.21 If the contractor fails to deploy the above Engineer/Supervisor/ Technician at appropriate time of commissioning, BHEL Engineer will have the right to withhold the payment towards commissioning activities as defined in terms of payment.

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- 1.15.22 T&P / instruments required for testing are to be arranged by the contractor
- 1.15.23 All commissioning/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.
- 1.15.24 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.
- 1.15.25 **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.
- 1.15.25.1 PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS)
- a) Calibration and checking of instruments mounted on the actuators and setting stroke length of the actuator.
 - b) Servicing of positioners, position transmitters, limit switches, solenoid valves, air lock-off valves, removing/replacement of defective components, copper tubes etc., if necessary.
 - c) If the actuator is to be removed for attending to any mechanical problems, removing of copper tubes, cables etc. reconnecting and re-commissioning of the actuators is to be done.
 - d) Testing and checking the remote/local operation in Auto as well as Manual mode.
 - e) Fixing of instruments if supplied as loose items.
 - f) Attending to any defects till the contract period.
- 1.15.25.2 FLOW METERS/ SWITCHES
- a- Checking the calibration and servicing if required.

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- b- Setting the alarm value
- c- Replacement of defective components if any

1.15.25.3 LIMIT SWITCHES & LEVEL SWITCHES

- a) Checking the operation
- b) Replacing defective components if required

1.15.25.4 SOLENOID VALVES

- a) Checking the healthiness of coil
- b) Checking the operation
- c) Replacement of defective components if required.

1.15.25.5 TEMPERATURE ELEMENTS (MOTORS AND GENERATORS WINDING AND BEARING)

- a) Checking the healthiness
- b) Replacement of defective element (only for bearing)

1.15.25.6 DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL)

- a) Checking the calibration
- b) Fixing of bulbs and extending Power supply
- c) Replacing defective components

1.15.25.7 INSTRUMENTS MOUNTED ON THE EQUIPMENTS/ SKIDS/ PANELS

Scope of work covers removal, re-calibration, re-fixing, and re-termination of cables, checking the continuity, replacing any defective parts or replacing the total instrument, if required.

NOTE:

The scope of work covered in 1.13.9 also includes collecting the replacement instruments/parts from BHEL/customer stores, stockyard etc.

Separate group shall be identified for commissioning. The above group shall be available right from Trial run to full load operation including shift operation.

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- 1.15.26 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.
- 1.15.27 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.
- 1.15.28 All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.
- 1.15.29 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.
- 1.15.30 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.
- 1.15.31 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.
- 1.15.32 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.
- 1.15.33 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

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requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

- 1.15.34 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.
- 1.15.35 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.
- 1.15.36 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.
- 1.15.37 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 as per the painting specifications of customer / BHEL like supports, racks, frames, canopy, LIE/LIR/LGB, impulse pipes etc. carried out by the contractor. Painting shall be carried out for any bare copper tube also.
- 1.16.2 In the case of steel fabricated items, raw steel after fabrication has to be surface 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 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.,
- 1.16.6 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.
- 1.16.7 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

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- 1.16.8 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification / relevant BHEL document / customer's specifications.
- 1.16.9 The actual colour to be applied shall be approved by the customer before starting of actual painting work.
- 1.16.10 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.
- 1.16.11 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.
- 1.16.12 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
- 1.16.13 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.
- 1.16.14 PRESERVATION / TOUCH UP PAINTING
- 1.16.14.1 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.
- 1.16.14.2 Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with touch up coat of red oxide primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.
- 1.16.14.3 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.
- 1.16.14.4 Touch up painting only is generally required for trays, control panels, junction boxes and full painting shall be required only for specific equipments as per the scope of erection.
- 1.16.14.5 All damaged painted surfaces shall be cleaned and coated with two (2) coats of primer followed by a finishing coat of approved colour.
- 1.16.14.6 All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.

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

GENERAL TERMS AND CONDITIONS OF REVERSE AUCTION

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

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

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

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VOLUME 1A

PART- II

CHAPTER 2

GENERAL TECHNICAL REQUIREMENTS AND GUIDE LINES FOR INSTALLATION, TESTING & COMMISSIONING

2.2.1 Guidelines for Installation of C & I Equipments

- 2.2.1.1 Instruments location shall be decided to the convenience of operation and maintenance. The location shall have least mechanical vibration and placed where corrosive, toxic and explosive gases and dust particles will not deposit and the place is not subject to high-temperature atmosphere or radiation. However, actual location shall be decided in consultation with customer/consultant.
- 2.2.1.2 Maintenance platforms & approach facilities shall be provided for all sensing & primary devices wherever possible. Instruments shall be located in weatherproof enclosures and wherever required suitable canopy shall be provided.
- 2.2.1.3 High & Low pressure impulse lines shall not be grouped and run together. Also impulse lines for explosive & inert gases shall not run together.
- 2.2.1.4 Impulse lines of high pressure steam, harmful gases, etc. shall not be brought into the control room, as far as possible.
- 2.2.1.5 Intrinsically safe circuits shall be used for explosion hazardous areas.
- 2.2.1.6 Separate cable routing shall be followed for high and low voltage lines.
- 2.2.1.7 All electrical equipments shall meet the requirements of Indian Electricity Rules.
- 2.2.1.8 Wherever severe vibrations are expected, shock absorbers shall be provided
- 2.2.1.9 Installation of instruments with radioactive isotopes, mercury and other toxic substances shall be as per statutory regulations provided by authorities.
- 2.2.1.10 Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used if CJCBs are not provided..
- 2.2.1.11 Orifice plates or flow nozzles must be provided with at least 10D upstream and 5D downstream straight length of pipe from bends tees, branch pipes & control valves.
- 2.2.1.12 Pressure gauges shall be provided with snubbers, syphons (for more than 100°C), 3 way valve manifolds wherever applicable.

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- 2.2.1.13 For pneumatic instruments, air shall be dry & free from oil. Air must be supplied from oil-free compressors specially erected for this purpose. After drying, air must be stored in receiver. Pressure gauges must be provided on each supply line and after the pressure reducer.
- 2.2.1.14 Correct level (height) between detecting element and tapping point and transmitter shall be maintained.
- 2.2.1.15 The equipment shall maintain its normal posture (level, perpendicular, front and back).
- 2.2.1.16 Connection between detecting element/tapping point and transmitter shall be maintained at short distances wherever practicable to avoid any time lag.
- 2.2.1.17 Orifice plates and control valves shall be mounted on process piping, only after completion of cleaning of the process piping in order that these instruments may not suffer damage from metal waste, etc.
- 2.2.1.18 For details of installing each measuring instruments, instruction manual issued by the respective manufacturer of instruments may be referred to, wherever necessary.
- 2.2.1.19 The drain pipes shall be terminated in a common closed header and finally the common header shall be connected to plant open drain.
- 2.2.1.20 Impulse pipe material shall be identified for each individual pipe prior to its use at site. For this purpose coloring is to be done immediately after receipt.

2.2.2 Guide Line for Erection of IMPULSE LINES

- 2.2.2.1 All impulse lines burrs and airlines shall be thoroughly cleaned of any foreign matter by cleaning with compressed air and the same shall be done before installation.
- 2.2.2.2 The routing of pipelines shall include sufficient flexibility near tappings to allow for thermal expansion of the process equipment.
- 2.2.2.3 The pipes shall be cold bent using hydraulic bending machines only.
- 2.2.2.4 The horizontal impulse lines shall be laid with proper slopes towards the tapping point.
- 2.2.2.5 Supports for piping and tubing shall be adequate and in no case exceed limits shown below:

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- a) 1/4" OD/ 3/8" OD Copper Continuous
- b) 1/2" NB Pipe/Tube 5'
- c) 3/4" NB Pipe/Tube 5'
- d) 1" NB Pipe/Tube 8'

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- 2.2.2.6 All impulse line welding shall be done through welding generator/rectifier and only structural welding could be done through welding transformer.
- 2.2.2.7 Impulse pipe of Alloy Steel/SS/CS shall be TIG welded wherever required. Welding of impulse pipe shall be carried out in accordance with BHEL welding procedure. The welding electrodes shall be approved by BHEL welding Engineers. Impulse pipes welders shall undergo welding Test and approved by BHEL welding engineer at site.
- 2.2.2.8 Minimum number of fittings shall be used on all lines wherever possible, to keep threaded joints to a minimum wherever thread connections are to be made.
- 2.2.2.9 The impulse pipe laying is recommended to be limited to a maximum of 10 metres (each limb) generally, unless otherwise specified, to have optimum response from the transmitter. However, this will depend upon plant layout.
- 2.2.2.10 Where the tapping point is subjected to mechanical shift due to heating/cooling of main equipment, care should be taken to route the impulse pipe in such a way as to absorb the shift of tapping point without straining the impulse piping. To accommodate this, sufficient loop for the impulse pipes can be provided near to the tapping point.
- 2.2.2.11 Alternatively hose assembly - S.S. flexible may be used for connection between tapping point and impulse pipe.
- 2.2.2.12 The expansion bends are to be avoided as far as possible, as these act as air/sedimentation traps hampering the system performance.
- 2.2.2.13 Impulse piping shall be arranged as short as possible with a minimum of bends.
- 2.2.2.14 Horizontal piping shall be avoided and 1/10 slope shall be maintained.
- 2.2.2.15 Pipes shall not be laid parallel to high temperature process piping.
- 2.2.2.16 Pipe joints shall be carried out using sockets and flanges. Union fittings may be used when pressure is low. In the case of D.P. instruments both piping on low side and high side shall be maintained at same length and in the same route.
- 2.2.3 Impulse Piping for Air & Flue Gas System**
- 2.2.3.1 For furnace pressure and furnace flue gas, suitable piping for air and furnace flue gas pressure, the impulse pipe shall be arranged to rise vertically from

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the tapping point to a distance at least of 300 mm before a change of direction is made.

2.2.3.2 Arrangements should be made for air purge in the impulse piping system at the end of the instrument airline or roding facilities may also be provided with suitable tees and cross.

2.2.3.3 In order to take care of the boiler expansion, suitable flexible connecting pipes can be arranged either at the tapping point end or at the instrument end.

2.2.4 Impulse Piping for Vacuum Measurement

The measuring instruments used on vacuum measurement should always be installed above the level of the tapping point in order to minimise measuring errors as much as possible. A suitable condensing chamber can be arranged which will eliminate the condensate or any blocking in the impulse pipe.

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2.2.5 Impulse Piping for Steam and Water System

- 2.2.5.1 As a rule, instrument installation position for steam and water shall be downward from root valves.
- 2.2.5.2 Impulse pipes shall have a minimum slope of 1:10 and shall be supported at every 2 metres length.
- 2.2.5.3 At the transmitter end, the connection can be either through 2 way valve manifold or nipple with coupling.
- 2.2.5.4 In case 2 way manifold used and connected with nipple and coupling, it is necessary to provide tee with plug for purging or venting. The impulse pipe connection to the transmitter from the main pipe may be either upper side or lower side of the transmitter. In any case sufficient slope shall be maintained.
- 2.2.5.5 Some supplier recommends capillary type tube for transmitter connection from the impulse pipe to instrument by using S.S. tube and compression fittings.
- 2.2.5.6 It is always preferable to mount the instrument below the tapping points because the condensate shall protect the instruments against high temperature. In any case, the temperature entering the instrument should not exceed 150 F. In case the instrument is installed above tapping, before opening the process root valves, the impulse pipe shall be filled with water.
- 2.2.5.7 In the case of high temperature steam applications, sufficient length or siphon shall be provided to ensure certain length of condensate is formed thereby protecting breaking the measuring instruments from high temperature. Snubbers can also be provided if there is likely to be any pulsating of the medium measured.

2.2.6 Bending

- 2.2.6.1 It is recommended for cold bend for the impulse pipes with the help of a hydraulic bending machine to achieve a particular shape.
- 2.2.6.2 Use of 45° elbow and 90° bends (ready-made) is restricted to bare minimum to minimise the number of joints in a system. Hot bending is not to be used as this leads to flattening of pipes at the bends and also results in thinning of walls, apart from introducing changes in metallurgical properties of the pipe material.

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2.2.6.3 Hot bending may be permitted for carbon steel pipe for low pressure service as instructed by supervisor only when it cannot be avoided. In the case of 90° bending radius shall be more than 3 times the outside diameter of pipe and in the case of 'u' bending, radius of bending shall be 5 times the outside diameter of pipe. When the radius of bending becomes small, elbow fitting shall be used.

2.2.6.4 Large bending shall be so made as to form smooth curve.

2.2.7 Cutting

- Pipe cutter or wheel grinder shall be used for pipe cutting.
- Gas cutting shall be avoided.
- Burr inside the cut end shall be removed.
- The cutting surface shall be as perpendicular to the axis as possible.

2.2.8 Impulse Pipe Welding

Generally, welding of impulse pipe and fitting shall be carried out by arc welding and socket welding is adopted. Welding shall be performed by a qualified welder. Only D.C. arc welding is recommended for impulse pipe. Motor generator is preferred to rectifier transformer, since it may damage the welding joints due to surge.

In order to prevent the cracking of the weld it is recommended to provide a small gap between the bottom of the socket and pipe end.

2.2.9 Testing

On completion of pipeline, installation, the pipelines shall be hydraulic tested. Contractor shall arrange for hydraulic pump and standard gauges and conduct the test satisfactorily.

The impulse lines shall be isolated from the instruments and tested at 2 times the maximum working pressures. The fall in pressure shall not be more than 1 Kg/Cm² or 1% of the working pressure whichever is less, in 30 minutes and there shall be no leaks, at any of joints/welds, when isolated from source of press.

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2.2.10 Guidelines for Installation of Pneumatic Line

- 2.2.10.1 Copper tubing shall be connected with Olive type of compression fittings,
- 2.2.10.2 When two or more lines run together, the joint in the adjacent alternate line shall be a offset.
- 2.2.10.3 In case of copper tubing, the single run copper tube may be supported with an angle. However, suitable trays shall be used for more than one tubing.
- 2.2.10.4 Multi-core copper tubing shall not to be bend less than 10 deg and D is the OD if the multi-core copper.
- 2.2.10.5 All air distribution, main and branch lines shall be galvanised internally as well as externally and the galvanised pipe, never, shall be braced or welded.
- 2.2.10.6 The joints shall be screwed with Teflon tapping wherever the pipes are to be removed frequently for cleaning and other purposes and suitable union fittings shall be used.
- 2.2.10.7 Care shall be taken while taking a branch pipe to see that the line is not taken from the lower part of the main line or main header in order to avoid entry of any drain or dust into the system.
- 2.2.10.8 Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.
- 2.2.10.9 Care shall be taken when removing the PVC sheeting, while connecting the copper tube. The exposed portion after jointing shall not be excessive and also while removing PVC, the tube should not get damaged. Pipe cutters should not be used for cutting the copper tube, instead the specific copper tube cutter shall be used. Similarly, for bending copper tubes, specific copper tube bender should be used and the radius of the bending shall be more than 2.5 times of the OD of the copper tube.
- 2.2.10.10 While using the pipe cutter, care shall be taken to remove burr from the cutting side.
- 2.2.10.11 In locations where the copper tube is likely to be damaged from outside, the copper tube can be routed near a different pipe. While laying copper tube either inside angle or trays, the tube shall be supported at least at every one meter distance.
- 2.2.10.12 While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

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2.2.11 Instrument Air line Testing

- All instrument air lines shall be isolated from the instruments and pressurised pneumatically to maximum working pressure. It shall then be isolated from the source of pressure and fall shall be less than 1 psi in 20 minutes.

- All pneumatic signal lines shall be disconnected and blown through with instrument air. The line shall be blanked off and pressurised pneumatically 20 psi, and checked with soap solution for leak.

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2.2.12 General Guidelines on Installation of Flexible Hoses

- 2.2.12.1 Flexible hoses can be classified into two broad categories, viz., Rubber hoses and Metallic hoses. The selection of the hoses is made depending upon the service conditions (pressure, temperature and other environmental conditions).
- 2.2.12.2 Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shrinkage or expansion. (However, excessive slack in hose lines is one of the most common causes of poor appearance).
- 2.2.12.3 At bends, provide enough hose for a wide radius curve. Too tight a bend pinches the hose and restricts the flow. The line could even kink and close entirely. In many cases, use of the right fittings or adapters can eliminate bends or kinks.
- 2.2.12.4 In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible and proper installation protects metal parts from undue stress, and avoids kinks in the hose.
- 2.2.12.5 Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.
- 2.2.12.6 The service life expectation of a flexible hose mainly depend on the correct installation layout. In most cases, when flexible hoses fail prematurely, the reason of failure may be found in an incorrect layout.
- 2.2.12.7 As a rule, the hose is not to be bent over its limit of elasticity. The choice of the right hose length is of crucial importance. The hose should not be subject to torsion. Torsion can be usually eliminated by changing the layout.

2.2.13 General Notes on Installation of Local Instrument Racks and JB Frames

- 2.2.13.1 In cases where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.
- 2.2.13.2 In cases where the local instrument stands are to be installed on the base plate, the stand can be placed on an angle and the same can be welded. However, in cases where there is a probability for removal of stand is likely to arise, it shall be fixed by bolts.

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- 2.2.13.3 Installation of local junction boxes shall be installed in such a way that they are fixed on a column by welding or by fixing bolts.
- 2.2.13.4 Local Instrumentation rack, which shall be installed utilising the Beam and Structure, shall be fixed by welding. Care shall be taken while deciding the location in order to ensure that no hindrance is caused to the maintenance personnel in their moving space within the work area. Further, as a standard practice, it should be ensured that no instrument stands/racks/JBs shall be supported by/welded on to any of the working equipments, or even hand griddled or floor griddled, as per safety norms.
- 2.2.13.5 Proper care should be taken to ensure that welding of the stand on any structure or Beam is fully welded.
- 2.2.14 General Guideline on Flow Instruments Installation**
- 2.2.14.1 Extreme care shall be taken when welding and assembling the flow element on the pipe. Any misalignment or rough particle or edge inside the welded area may cause inaccuracy and this will increase as the flow increases.
- 2.2.14.2 Flow elements should always be located in upstream from any valve. Downstream side of valve shall no longer be a homogenous mixture and this may cause erratic behaviour of reading periodically.
- 2.2.14.3 Care shall be taken while welding the impulse pipe. Improper arrangement of piping of DP instruments can create error in the reading and even it gives an indication of negative flow of steam even though the flow is to be positive. Inadequate exchange of steam and condensate in the piping may cause negative flow. The presence of burr or dirt in the pipe can impede the flow of condensate back to the pipe, and when this happens, the pipe becomes full of water and has the effect of creating negative head.
- 2.2.14.4 Always $\frac{3}{4}$ " to 1" pipe is recommended for free flow condensate. Gate valve shall be used for the tapping and pipe should be insulated up to condensing pot.
- 2.2.14.5 The Measuring instrument shall be located close to the flow-sensing element. The speed of response is reduced if there is a long run,
- 2.2.14.6 The orifice plates shall be installed such that the extreme face is perpendicular to the axis of the pipe within the +2 deg or -2deg. and it should

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be ensured that when the extreme face is facing the direction of flow, invariably the sign of positive (+) is marked on the upstream.

- 2.2.14.7 Location of Flow element should have clear straight run of 10D in upstream and 5D in downstream.
- 2.2.14.8 For non-viscous liquid flow measurements, the best location for the instruments shall be below the pipeline, If the instrument is above the line, more maintenance will be involved. Suitable vapour traps shall be provided.
- 2.2.14.9 In the case of air and gas flow measurement system, as part of basic requirement, it should be transmitted to the instruments without any change in the differential head due to leakage.
- 2.2.14.10 If the flow of any dry gases are to be measured, the location of instrument can be kept above or below the tapping points.
- 2.2.14.11 For air flow measurements, it is always preferable to install the instruments above the pipeline. Incase, if the instrument must be installed below the duct/pipeline, suitable Dust Collection Chamber can be installed.
- 2.2.14.12 The condenser pot should be located nearer to the tapping point and both condenser chamber should be at the level of upper tapping,
- 2.2.14.13 The unequal level will cause significant error due to false heads. If the flow nozzle is installed in vertical pipe, the lower tapping pipe which is bent and taken up to upper tapping in order to align with the upper condensate pot, must be insulated, otherwise, error is created when the bent pipe fills with condensate. The error may add or subtract depending upon the direction of flow.
- 2.2.14.14 For flow measurements, the instruments should always be located below the condenser pot, otherwise, the condensate will be lost from the system and the instrument will reach 'O' during the shutdown and the total system must be vented after the start up of the boiler in order to remove Air and Vapour which might have got entrapped.
- 2.2.14.15 In an installation where the instruments must be located above the tapping points and the condensing chamber should be equally located above the instruments the pipeline up to the condensing pot should be insulated.
- 2.2.14.16 In the case of viscous fluids, flow measurements which are likely to freeze or concealed in the pressure pipe or like such corrosive type fluids, suitable

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sealing chamber shall be used, the sealing liquid should not mix or react with the medium to be measured.

2.2.14.17 The commonly used sealing liquid includes water, light oil, glycerol, ethylene glycol and mixtures of the last two with water.

2.2.14.18 The sealing chambers, in each pressure pipe, should be installed at the same level and as close as possible to the pressure tapplings.

2.2.14.19 The general arrangement for pressure tapplings from the Sealing Chamber to the instrument is shown in the sketch.

2.2.14.20 The flow elements should be inspected before installation to find out the presence of any corrosion/rusting or any blockage on the pressure tapping holes or any deposits on the face of the orifice plate.

2.2.15 General Guideline on Installation of Valves

2.2.15.1 Primary isolating valves (root valves) must be located at the tapping which can be of globe valves.

2.2.15.2 These valves shall be installed where access is possible.

2.2.15.3 Secondary isolating valves shall be located at the end of inter-connecting pipe. It should be as nearer as possible to the measuring instruments and should be of needle type.

2.2.15.4 For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.

2.2.15.5 In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.

2.2.15.6 In viscous fluids, suitable steam tracing shall be provided.

2.2.15.7 These valves are always located as nearer to the measuring device as possible.

2.2.16 Blowdown Valves or Drain Valves

a) These valves are fixed at the lowest end of impulse pipe.

b) In the case of high-pressure line always 2 valves shall be fitted in series. Normally, these valves will be of globe type.

c) For low-pressure application, single valve is used.

d) In case of air and flue gas measurements, either a plug or a suitable gate valve of gunmetal 'on/off' valve shall be provided.

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- e) The drain valve shall be connected to the common drain header which finally is terminated at plate operation drain system.

2.2.17 PAINTING

All the supporting steelworks impulse pipe shall have protective painting. The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour DECIDED by the site engineer. (More details please refer Part 1 scope of works). After cleaning the surface is painted with one coat of Red oxide zinc chromate primer conforming to IS 2074 and allowed to dry completely. The primer-coated surface is painted with two coats of final painting of desired colour which shall be selected from IS-5.

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2.2.18 GUIDELINES FOR CABLE LAYING

- 2.2.18.1 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.
- 2.2.18.2 In case of multicore 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.
- 2.2.18.3 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.
- 2.2.18.4 GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 2.2.18.5 In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.
- 2.2.18.6 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.
- 2.2.18.7 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.
- 2.2.18.8 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 up to a height of 2000mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.
- 2.2.18.9 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.

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- 2.2.18.10 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.
- 2.2.18.11 Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.
- 2.2.18.12 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.
- 2.2.18.13 If required, a few number of cables in exceptional areas may be directly buried into the earth.
- 2.2.18.14 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.
- 2.2.18.15 At certain places where hazardous fumes/gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.
- 2.2.18.16 In corrosive atmosphere, PVC conduits shall be used for cables.
- 2.2.18.17 Single core cables, when pulled individually shall be taken through PVC pipes only.
- 2.2.18.18 Laying and installation of power, control and special cables shall generally conform to IS : 1255
- 2.2.18.19 The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 2.2.18.20 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.
- 2.2.18.21 Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.
- 2.2.18.22 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

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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.

- 2.2.18.23 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.
- 2.2.18.24 When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.
- 2.2.18.25 Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.
- 2.2.18.26 Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.
- 2.2.18.27 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.
- 2.2.18.28 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.
- 2.2.18.29 Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:
- a) HT cables shall be laid in the top tier(s)
 - b) LT power cables to be laid in the tray(s) below the HT cable trays.
 - c) LT control cables to be laid in the Tray(s) next below to the LT power cable (trays)
 - d) Special control cables including screened control cables to be laid in the bottom most tray(s).

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2.2.18.30 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.

2.2.18.31 When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required.

In hierarchical order:

- a) Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.
- b) LT power cables are mixed up with control cable with clear minimum gap of 150mm between them.
- c) LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.
- d) LT power cables are mixed up with special control cables with clear minimum gap of 200mm between them.

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- 2.2.18.32 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.
- 2.2.18.33 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.
- 2.2.18.34 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 6mm thickness.
- 2.2.18.35 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.
- 2.2.18.36 No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GI conduits/pipes in trefoil formation only.
- 2.2.18.37 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.
- 2.2.18.38 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.
- 2.2.18.39 Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.

2.2.19 Support Spacings & Clampings

Support spacing and clamping suitably provided and as required

2.2.20 Laying of cables directly buried in ground

Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.

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2.2.21 Codes and Standards

Installation of cabling work shall comply with the following Indian Standards (Latest editions) :

- IS 1255 Code of practice for installation and maintenance of power cables upto and including 33 KV rating.
- IS 732 Electrical wiring installation (system voltage not exceeding 650 V).
- IS 5216 Guide for safety procedures and practices in electrical works.
- IS 226 Structural steel (Standard quality)
- IS 800 Code of practice for use of structural steel
- IS 316 Code of practice for use of metal arc welding for general construction in mild steel.
- IS 1363 Hexagonal bolts, nuts and screws
- IS 1572 Electroplated coatings of cadmium on iron and steel.
- IS 2629 Code of practice for hot dip galvanising for iron and steel.
- IS 2633 Method of testing uniformity of coating on zinc coated articles.

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
- 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.

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2.2.22 Guidelines For Erection of Cable Trays, GI PIPES, Supports and Accessories

- 2.2.22.1 Constructional details and supporting arrangement for the cable trays shall be as shown in the drawings which will be handed over to the successful bidder. All cable trays, vertical raceways and supporting steel work shall be installed along the routes as indicated in the drawings and as per the instructions of the Engineer-in-charge. The contractor has to fabricate and install complete tray supporting structures as per the drawing/site requirement.
- 2.2.22.2 Wherever specified or directed by Engineer, the contractor shall install galvanised MS sheets covers over cable trays. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.
- 2.2.22.3 The contractor shall install all angles, channels, beams, hangers, brackets, clamps etc. as may be necessary to suit the actual site conditions to support the cable trays.
- 2.2.22.4 Straight pieces of standard MS angles/channels shall be used for fabrication of supports/racks. All welded joints shall be smooth enough to provide a good appearance and shall not cause injury to working personnel.
- 2.2.22.5 Cable trays within cable trenches, tunnels and basements shall be of ladder type. Bottom most tray within plant buildings for overhead runs of trays shall be of perforated type. Cable trays in the areas exposed to coal dust shall be installed in vertical formation. Wherever due to layout constraints, it is not possible to install the trays in vertical formation with Engineer's prior permission installing the trays in horizontal formation may be considered.
- 2.2.22.6 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way or maintenance of adjacent equipment.
- 2.2.22.7 For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.
- 2.2.22.8 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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- 2.2.22.9 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.
- 2.2.22.10 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.
- 2.2.22.11 Bends of GI pipes/conduits shall be made without causing damage to the pipes/conduits.
- 2.2.22.12 Occupancy of conduits shall not be greater than 40%.
- 2.2.22.13 The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanised steel.
- 2.2.22.14 Transportation and storage of cable drums
- 2.2.22.15 Transportation and storage of cable drums shall generally conform to the requirements of IS : 1255
- 2.2.22.16 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.
- 2.2.22.17 The cable drums shall be transported on wheels to the place of work.
- 2.2.23 GUIDELINES FOR Cable Termination and Jointing**
- 2.2.23.1 Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.
- 2.2.23.2 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.
- 2.2.23.3 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 by the column at no extra cost as part of the termination.
- 2.2.23.4 All cable entries in the equipment shall be sealed after glanding the cables..
- 2.2.23.5 Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor.

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- 2.2.23.6 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.
- 2.2.23.7 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes/nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.
- 2.2.23.8 Screened control cables of 0.5 sq. mm cross-sectional area shall be terminated by means of wire rapping system.
- 2.2.23.9 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents supplied.
- 2.2.23.10 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.
- 2.2.23.11 Termination and jointing of aluminium/copper conductor power cables shall be done by means of compression method using compression type aluminium/tinned copper lugs.
- 2.2.23.12 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.
- 2.2.23.13 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.
- 2.2.23.14 Junction boxes shall be used, wherever required, for jointing of control cables.

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2.2.23.15 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.

2.2.24 Design Requirements of Items supplied for cabling installation work (if supply is covered in contractor scope).

2.2.24.1 Strip Cable Clamps

- a) Strip Clamps shall be of aluminium alloy or cast steel or M.S. and shall be used to fasten the group of multicore cables on the tray.
- b) Clamps shall be of simple construction, made of 4 mm thick, 25 mm wide strip to cover the entire width up to 300 wide tray and part of the tray for more than 300 wide trays. Strip shall have two right angle bends for fixing on the rung with two bolts.
- c) Clamps shall be of different lengths for different sizes of tray width. The maximum size of clamp width shall be 300 mm and for cable trays of greater width, two clamps shall be used.

2.2.24.2 Self Locking Clamps

- a) Clamps shall be of nylon material/fibre glass.
- b) Clamps shall have self-locking feature when the cord is looped.
- c) Clamps shall be provided with manual lock release.
- d) Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.
- e) Type test certificates to ascertain the strength of clamps shall be submitted for purchaser's approval.
- f) Nylon self locking clamps shall be of BHEL approved make only.

2.2.24.3 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.

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- 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.

2.2.24.4 Tags

- a) Cables shall be provided with cable number tags for identification.
- b) Cable tags shall be of durable fibre, aluminium, stainless steel sheets or lead. of suitable thickness
- 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.

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2.2.25 GUIDELINES FOR EARTHING Installation

- 2.2.25.1 All equipments shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.
- 2.2.25.2 The earthing conductors shall be mild steel/G.I. strips/wires. All connections from the equipments to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the successful tenderer.
- 2.2.25.3 A continuous earthing conductor shall be installed in all cables trays and securely clamped to each tray section by suitable connectors to form a continuous earthing system. When two or more trays supporting power cables run on parallel a continuous earthing conductors shall be provided on one tray only with tap offs to the control cable trays. All valve and damper motor and rapping motors will be earthed to this conductor.
- 2.2.25.4 All joints in the earthing system shall be welded type. Earthing connections to all equipment including motors shall be bolted type.
- 2.2.25.5 Earthing connections shall be free from tinning scale, paint, grease, rust or dirt at the time of making joint.
- 2.2.25.6 Metallic sheaths, screens/shields and armour of all multicore cables shall be bonded and earthed.
- 2.2.25.7 Earthing conductors along with their run on columns, beams, walls etc., shall be supported by suitable cleats at intervals of 750 mm.
- 2.2.25.8 Conduits shall be bonded together and grounded at all switchgear and control centres.
- 2.2.25.9 M.S.Earthing conductors shall be coated with one coat of bituminous paint, wrapped with a layer of bitumen tape and finally coated with bitumen paint. For site welded GI strips/wires required coat of aluminium paint should be given.
- 2.2.25.10 If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.

2.2.26 Guidelines for Erection of Control Panels and Distribution Boards

Erection

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- 2.2.26.1 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 channels will have to be grouted. Suitable concrete drilling machine shall be used for making hole on the concrete floor.
- 2.2.26.2 For the panels which are 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. Fabrication and erection of these support structures shall be carried out as per drawings.
- 2.2.26.3 All the panels/board shall be placed on its foundation or supporting structures and shall be assembled equipment as required. All equipment should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.
- 2.2.26.4 All the boards will be delivered in sections. Necessary interconnection of busbar, bolting of panels, left out panel/interpanel wiring, etc. will have to be done after assembling the panel.

2.2.27 The following points shall be checked up during erection

- a) Layout of foundation channels.
- b) Floor level covered by the panel with respect to main floor level.
- c) Location and serial no. panels.
- d) Positioning of panels.
- e) Verticality of panels and breaker truck to station earth.
- f) Earthing of panels and breaker truck to station earth.
- g) Lugs for termination of HT and LT cables.
- h) Mounting and fixing arrangements all modules.
- i) Check the operation of:
 - i. Remote control
 - ii. Various required - closing / tripping / alarm / indications / interlocks

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Installation position of instruments and relays
Operation of relays and instruments.

j) AC / DC supplies for panel.

k) Tightness of terminal connections for HT & LT connections.

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

2.2.28 415 V switchgear and Electrical panels tests(as applicable)

a) IR Test on each pole of breaker

b) IR test on control circuit

c) Measurement of contact resistance for all three phases of breaker

d) Measurement of resistance of the closing and tripping coil of breaker

e) Checking the close trip operation at 70% and 100% of the rated auxiliary D.C. Voltage.

f) Checking of interlocks provided and tripping of breaker through relays

g) Space heater operation check

h) Opening and closing time check

i) Control and metering circuit checks.

j) Primary and secondary injection tests.

k) Thermal overload relay testing and checking

l) Calibration of all instruments and meters

m) Phase rotation checks

n) High voltage test on 7C.1.3KV switchboard

2.2.29 Cutting & Wastage Allowance

The following scrap allowances are permissible:

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	non-salvageable	unaccountable
1. Length below 0.5 M steel pipes, SS/Cu tubes, Single pair cables	2%	0.5%
2. Length below 20m multi cable, multitubes	2%	0.5%

2.2.30 Guidelines for handling of solid state modules:

- All the solid-state modules shall be handled by qualified person.
- Electronic modules should only be touched when it is absolutely essential.
- Before touching any electronic modules, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strip.
- The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing atleast 65% cotton.
- PCB should always be held by the front panel or by the module frame and the electronic components should never be touched.
- The electronic modules should never be placed close to television sets or CRT units.
- Soldering irons and any other tools used must be grounded.
- All modules using CMOs components are packed in antistatic bags, when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.

2.2.31 Guidelines for landing and storage of Electronic Cubicles/sub-assemblies / loose items.

- 2.2.31.1 Immediately after unloading at site, the electronic equipment should be kept in the covered area. Handling and lifting of the package should be done without jerks or impacts. Packing case should not be dripped or slid along the floor under any circumstances. Suitable forklift should be used to move the case to its final position. All the above points are to be strictly followed as the

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electronic equipments cannot withstand any stress due to vibration and shock.

- 2.2.31.2 After unloading at site, the package of the equipment shall be inspected for external damage. In case the package is damaged, the package number and details of the damage should be noted. The details of the damage should be reported to the responsible site Engineer.
- 2.2.31.3 Cases should be opened/unpacked using correct nail pullers. While opening the planks, care should be taken to see that the equipment is not damaged. Cases should not be unpacked in areas where they are exposed to rain water/liquid splashing, dust or other harmful materials like chlorine gas, sulphur dioxide etc.
- 2.2.31.4 After opening the case, all supports provided for transport are to be removed with due care.
- 2.2.31.5 Hinged frames should not be opened when equipment is not secured to the floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to the bottom wooden pallet.

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2.3.1 SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS IF MENTIONED IN THE BOQ

1. Clamps
 - a. Material & Type : Nylon self locking ties aluminium strips clamps as per Part 1
 - b. Sizes : To meet the requirements of Part 1
2. Ferrules : As per Part 1
3. Tag
 - a. Material : Aluminium/Fibre/Stainless Steel
 - b. Markings : Engraving/Embossing/Printing
 - c. Size : As required.
4. Cable lugs : Copper/Aluminium (crimping type)
5. Clamp Spacing:
 - a. 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 150mm Whichever is less

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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 35 mm 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)

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)

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Note:

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

6. Cable termination:

Type of Lugs:

- a. Power Cables : Copper/Aluminium/Both crimping type
- b. Control Cables : Copper pin type, copper screw type, Direct termination
- c. Special Cables : Pin type, maxi-termi type.

7. Wastage Allowance:

- a. HT cables : 1%
- b. LT cables above 70mm : 1%
- c. LT cables upto 70mm : 1%
- d. Control & Special cables : 1%
- e. Fire Survival cables : 1%
- f. Steel materials (for cable trays/tray support installation) : 1% by weight