TENDER SPECIFICATION
BHEL: PSSR: SCT: 1528

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT & LT Electrical Package including Supply & Applications of touch-up, preservation and final painting of above package

at

1 X 600 MW – Stage-II of Kakatiya Thermal Power Project,
Chelpur, Warangal Dist. AP

VOLUME –I BOOK – I

TECHNOCOMMERCIAL BID (Book I & II)

Book-I consists of

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

Book-II (Rev 01, 1st June 2012) consists of

- **Volume-IB : Special conditions of Contract,**
- **Volume-IC : General conditions of Contract**
  Amendment 01; 15 April 2013
- **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: 1528

for

Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT & LT Electrical Package including Supply & Applications of touch-up, preservation and final painting of above package of 1 X 600 MW – Stage-II of Kakatiya Thermal Power Project, Chelpur, Warangal Dist. AP.

One set of Tender documents consisting of

1) Technocommercial bid - 2 copies
2) Price bid - 2 copies

Book Sl no …….

Issued to

M/s

Refer NIT for Last date of submission
Please note this tender document is not transferable

For and on behalf of
Bharat Heavy Electricals Limited

General Manager / Contracts

Place: Chennai -35
Date:

NOTICE INVITING TENDER

(As per uniform procedures for subcontracting of installation works of Power Sector Regions - Rev 01 1st June 2012, Amendment: 01 Dt. 15 April 2013)

Bharat Heavy Electricals Limited

Ref: BHEL PSSR SCT 1528 **Paper Advertisment Date: 07/05/2013**

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 1528**	
ii	**Broad Scope of job**	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT & LT Electrical Package including Supply & Applications of touch-up, preservation and final painting of above package of 1 X 600 MW – Stage-II of Kakatiya Thermal Power Project, Chelpur, Warangal Dist. AP	
iii	**DETAILS OF TENDER DOCUMENT**		
a	Volume-IA	*Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc*	*Applicable*
b	Volume-IB	*Special Conditions of Contract (SCC)* Rev. 01 Dt. 01 Jun 2012	*Applicable*
c	Volume-IC	*General Conditions of Contract (GCC)* Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 15 April 2013	*Applicable*
d	Volume-ID	*Forms and Procedures* Rev. 01 Dt. 01 Jun 2012	*Applicable*
e	Volume-II	*Price Schedule (Absolute value).*	*Applicable*

iv	**Issue of Tender Documents**	**1. <u>Sale from BHEL PSSR Regional office at Chennai</u>** **Start : May 14, 2013** **Closes : Jun 03, 2013 , Time :15.00 Hrs.** **2. From BHEL website (www.bhel.com)** Tender documents can however be downloaded from website till due date of submission	*Applicable*
v	**DUE DATE & TIME OF OFFER SUBMISSION**	**Date Jun 04, 2013, Time :15.00Hrs** **Place : <u>BHEL PSSR :Chennai</u>** ***Tenders can be submitted through post / representative / in person at Office of GM,SCT Dept., 7th floor, A-wing, BHEL, PSSR, Chennai-35.*** **Ph: 044 24330209, Fax: 044 24335920** (BHEL will not be responsible for any delay or loss of document sent by post)	*Applicable*
vi	**OPENING OF TENDER**	**Date : Jun 04, 2013, Time :15.30Hrs** Notes: (1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time. (2) Bidder may depute representative to witness the opening of tender	*Applicable*
vii	**EMD AMOUNT**	***Rs 2,00,000/-*** *(Rupees Two Lakhs Only)*	*Applicable*
viii	**COST OF TENDER**	*Rs 2000/-.*	*Applicable*
ix	**LAST DATE FOR SEEKING CLARIFICATION**	*At least 7 days before the due date of offer submission or two days before the scheduled date of pre-bid meeting whichever is earlier* *Along with soft version also, addressing to undersigned & to others as per contact address given below*	*Applicable*
x	**SCHEDULE OF Pre Bid Discussion (PBD)**	**Date: May 28, 2013. Time 10.00AM** at BHEL:PSSR:Chennai-35 change	*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	***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.	

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	
	ENVELOPE – I superscribed as : PART-I (TECHNO COMMERCIAL BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**:-	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	Duly filled-in `No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. **Note:** a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be placed after document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding.	

	(i) In case of acceptance of the deviations, appropriate loading shall be done by BHEL (ii) In case of unacceptable deviations, BHEL reserves the right to reject the tender.	
iii.	Supporting documents / annexure / schedules / drawing etc as required in line with Pre-Qualification criteria. It shall be specifically noted that all documents as per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact ph no, FAX no, etc.	
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	If appli cable
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification / NIT	
vii.	Notice inviting Tender (NIT)	
viii.	Volume – I A : Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	
ix.	Volume – I B : Special Conditions of Contract (SCC)	
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	
xiii.	Any other details preferred by bidder with proper indexing.	

	PART-I B	
	ENVELOPE – II superscribed as: PART-I (EMD/COST of TENDER) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**:-	
i.	1. Earnest Money Deposit (EMD) in the form as indicated in this Tender **OR** Documentary evidence for 'One Time EMD' with BHEL PSSR Chennai	

	2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)	

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

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

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

7.0 Deviation with respect to tender clauses and additional clauses/ suggestions/ in Techno-commercial bid/ Price bid shall NOT 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:**

Bidders capacity for executing the job under tender shall be assessed 'LOAD' wise and 'PERFORMANCE' wise as per the following:

I. **LOAD**: Load takes into consideration **ALL** the contracts of the Bidder under execution with BHEL Regions, irrespective of whether they are similar to the tendered scope or not. The 'Load' is the sum of the unit wise identified packages (refer Table-1) for contracts with BHEL Regions. The cut off month for reckoning 'Load' shall be the month, two (2) months preceding the month corresponding to the 'latest date of bid submission', in the following manner:

(Note: For example if latest bid submission is in Aug 2011, then the 'load' shall be calculated upto and inclusive of June 2011)

i). Total number of Packages

Total number of Packages in hand = P

Where

- 'P' is the sum of all unit wise identified packages under execution with BHEL Regions as of the cut off month defined above, including packages yet to be commenced, excepting packages which are on HOLD due to reasons not attributable to Bidder.

II. **PERFORMANCE:** Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all the Power Sector Regions of BHEL) SIMILAR to the packages covered under the tendered scope, excepting packages not commenced shall be taken into consideration. The 'Period of Assessment' shall be 6 months preceding the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the month two (2) months preceding the month corresponding to the 'latest date of bid submission', in the following manner:

(Note: For example if 'latest date of bid submission' is in Aug 2011, then the 'performance' shall be assessed for a 6 month period upto and inclusive of June 2011, for all the unit wise identified packages (refer Table I)

i). Calculation of Overall 'Performance Rating' for 'similar Package / Packages' for the tendered scope under execution at Power Sector Regions for the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for all the similar Package / packages', divided by the total number of Package months for which evaluation should have been done, as per procedure below:

a) $P_1, P_2, P_3, P_4, P_5, \ldots P_N$ etc be the packages (**under execution**/ executed during the 'Period of Assessment' in all Regions) **SIMILAR** to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = $\mathbf{P_T}$ (ie $P_T = P_1 + P_2 + P_3 + P_4 + .. P_N$)

b) Number of Months 'T_1' for which 'Monthly Performance Evaluation' as per relevant formats, should have been done in the 'Period of Assessment' for the corresponding similar package P_1. Similarly T_2 for package P_2, T_3 for package P_3, etc for the tendered scope. Now calculate cumulative total months '$\mathbf{T_T}$' for total similar Packages '$\mathbf{P_T}$' for all Regions (i.e $\mathbf{T_T} = T_1 + T_2 + T_3 + T_4 + .. T_N$)

c) Sum 'S_1 ' of 'Monthly Performance Evaluation' Scores ($S_{1\text{-}1}$, $S_{1\text{-}2}$, $S_{1\text{-}3}$, $S_{1\text{-}4}$, $S_{1\text{-}5}$,…. $S_{1\text{-}N}$) for similar package P_1, for the 'period of assessment' 'T_1' (i.e $S_1 = S_{1\text{-}1} + S_{1\text{-}2} + S_{1\text{-}3} + S_{1\text{-}4} + S_{1\text{-}5} + \ldots S_{1\text{-}N}$). Similarly S_2 for package P_2 for period T_2, S_3 for package P_3 for period T_3, etc for the tendered scope for all Regions. Now calculate cumulative sum 'S_T' of 'Monthly Performance Evaluation' Scores for total similar Packages '$\mathbf{P_T}$' for all Regions (i.e 'S_T '$= S_1 + S_2 + S_3 + S_4 + S_5 + \ldots S_N$.)

d) **Overall Performance Rating 'R_{BEHL}' for the similar Package/Packages** (**under execution**/ executed during the 'Period of Assessment') in all the Power Sector Regions of BHEL)**:**

$$= \frac{\text{Aggregate of Performance scores for all similar packages in all the Regions}}{\text{Aggregate of months for each of the similar package for which performance should have been evaluated in all the Regions}}$$

$$= \frac{S_T}{T_T}$$

e) Bidders to note that the risk of non evaluation or non availability of the 'Monthly Performance Evaluation' reports as per relevant formats is to be borne by the Bidder

f) Table showing methodology for calculating 'a', 'b' and 'c' above

Sl no	Item Description	Details for all Regions							Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
1	Similar Packages for all Regions → (under execution/ executed during period of assessment)	P_1	P_2	P_3	P_4	P_5	…	P_N	Total No of similar packages for all Regions = **P_T** ie Sum (Σ) of columns (iii) to (ix)
2	Number of Months for which 'Monthly Performance Evaluation' as per relevant formats should have been done in the 'period of assessment for corresponding similar Package (as in row 1)	T_1	T_2	T_3	T_4	T_5	…	T_N	Sum (Σ) of columns (iii) to (ix) = **T_T**
3	Monthly performance scores for the corresponding period (as in Row 2)	S_{1-1}, S_{1-2}, S_{1-3}, S_{1-4}, … S_{1-T1}	S_{2-1}, S_{2-2}, S_{2-3}, S_{2-4}, … S_{2-T2}	S_{3-1}, S_{3-2}, S_{3-3}, S_{3-4}, … S_{3-T3}	S_{4-1}, S_{4-2}, S_{4-3}, S_{4-4}, … S_{4-T4}	S_{5-1}, S_{5-2}, S_{5-3}, S_{5-4}, … S_{5-T5}	.. … … … …	S_{N-1}, S_{N-2}, S_{N-3}, S_{N-4}, … S_{N-TN}	---------

4	Sum of Monthly Performance scores of the corresponding Package for the corresponding period (as in row-3)	S_1	S_2	S_3	S_4	S_5	…	S_N	Sum (Σ) of columns (iii) to (ix) = $\mathbf{S_T}$

ii) Calculation of Overall 'Performance Rating' ($\mathbf{R_{BHEL}}$) in case 'similar Package / Packages' for the tendered scope ARE NOT AVAILABLE, during the 'Period of Assessment':

This shall be obtained by summing up the 'Monthly Performance Evaluation' scores obtained by the bidder in all Regions for ALL the packages, divided by the total number of Package months for which evaluation should have been done. 'R_{BHEL} ' shall be calculated subject to availability of 'performance scores' for at least.6 'package months' in the order of precedence below:

a) 'Period of Assessment.

b) 12 months preceding the cut-off month

c) 24 months preceding the cut-off month

d) 36 months preceding the cut-off month

In case, R_{BHEL} cannot be calculated as above, then Bidder shall be treated as 'NEW VENDOR'. Further eligibility and qualification of this bidder shall be as per definition of 'NEW VENDOR' described in 'Explanatory Notes'.

iii) Factor "L" assigned based on Overall Performance Rating (R_{BHEL}) at Power Sector Regions,:

Sl. No.	Overall Performance Rating (R_{BHEL})	Corresponding value of 'L'
1	=60	NA
2	> 60 and ≤ 65	0.4
3	> 65 and ≤ 70	0.35
4	> 70 and ≤ 75	0.25
5	> 75 and < 80	0.2
6	≥ 80	NA

III. 'Assessment of Capacity of Bidder':

'Assessment of Capacity of Bidder' is based on the Maximum number of packages for which a vendor is eligible, considering the performance scores of similar packages, as below:

Max number of packages P_{Max}= (R_{BHEL}- 60) divided by corresponding value of 'L'

i.e. (R_{BHEL}- 60)/L

Note:

i. In case the value of P_{Max} results in a fraction, the value of P_{Max} is to be rounded off to next whole number
ii. For R_{BHEL} = 60 , P_{Max} = '1'
iii. For $R_{BHEL} \geq 80$, there will be no upper limit on P_{Max}

The Bidder shall be considered 'Qualified' as per 'Assessment of Capacity of Bidder' for the subject Tender if $P \leq P_{Max}$ (where P is calculated as per clause 9.I)

IV. **Explanatory note**:

a) Similar package means Boiler or ESP or Piping or Turbine or Civil or Structure or Electrical or CI, etc at the individual level irrespective of rating of Plant, and irrespective of whether the subject tender is a single package or as part of combined/composite packages. Normally Boiler, ESP, Piping, Turbine, Electrical, CI, Civil, Structure, etc is considered individual level of package. For example in case the tendered scope is a Boiler Vertical Package comprising of Boiler, ESP and Power Cycle Piping (i.e the 'identified packages as per Table-1 below), the 'PERFORMANCE' part against sl no II above, needs to be evaluated considering all the identified packages (ie Boiler, ESP and Power Cycle Piping) and finally the Bidder's capacity to execute the tendered scope is assessed in line with III above

b) Identified Packages (Unit wise)

Table-1

	Civil	Electrical & CI	Mechanical
	i). Enabling works ii). Pile and Pile Caps iii). Civil Works	i). Electrical ii). CI iii). Others (Elec & CI)	i). Boiler & Aux (All types including CW Piping if applicable) ii). Power Cycle Piping/Critical Piping

	including foundations iv). Structural Steel Fabrication & Erection v). Chimney vi). Cooling Tower vii). Others (Civil)		iii). LP Piping iv). ESP v). Steam Turbine Generator set & Aux vi). Gas Turbine Generator set & Aux vii). Hydro Turbine Generator set & Aux viii). Turbo Blower (including Steam Turbine) ix). Material Handling x). Material Management xi). Material Handling & Material Management xii). Others (Mechanical)

c) Bidders who have not been evaluated for at least six package months in the last 36 months in the online BHEL system for contractor performance evaluation in BHEL PS Regions, wef July'2010 shall be considered "NEW VENDOR".

A 'NEW VENDOR' shall be considered qualified subject to satisfying all other tender conditions

A 'NEW VENDOR' if awarded a job (of package/packages identified under this clause) shall be tagged as "FIRST TIMER" on the date of first LOI from BHEL.

The "FIRST TIMER" tag shall remain till execution of work for a period of not less than 09 months, from the commencement of work of first package

A Bidder shall not be eligible for the next job as long as the Bidder is tagged as "FIRST TIMER" excepting for the Tenders which have been opened on or before the date of the bidder being tagged as 'FIRST TIMER'.

After removal of 'FIRST TIMER' tag, the Bidder shall be considered 'QUALIFIED' for the future tenders subject to satisfying all other tender conditions including 'Capacity Evaluation of Bidders'.

d) In the unlikely event of all bidders shortlisted against Technical and Financial Qualification criteria not meeting the criteria on 'Assessment of Capacity of Bidders' detailed above, OR leads to a single tender response on applying the criteria of 'Assessment of Capacity of Bidders' or due to non-approval by Customer, then BHEL at its discretion reserves the right to consider the further processing of the Tender based on the **Overall Performance Rating** 'R_{BHEL}' only, starting from the upper band.

e) 'Under execution' shall mean works in progress as per the following:

i. up to Boiler Steam Blowing in case of Steam Generator and Auxiliaries

ii. upto Synchronisation in case of all other works excepting sl no (i) and (iii)

iii. Upto execution of at least 90% of anticipated contract value in case of Civil & Structures (unit wise), Enabling works and upto 90% of material unloading (in tonnage) as per the original contract in case of MM Package.

Note : BHEL at its discretion can extend (or reduce in exceptional cases in line with Contract conditions) the period defined against (i), (ii) and (iii) above, depending upon the balance scope of work to be completed.

f) Performance evaluation in CL 9 above is applicable to Prime bidder and consortium partner (or Technical tie up partner) for their respective scope of work.

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 ,applicable wage structure, wage rules, 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.

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 satisfying the pre-qualification criteria specified in this NIT as per Annexure--1(as applicable) past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right NOT to consider offers of parties under HOLD.

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.

19.0 BHEL reserves the right to decide the successful bidder on the basis of Reverse Auction (RA) process. In such case all qualified bidders will be intimated regarding procedure / modality for RA 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 Void

24.0 The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL web site "www.bhel.com".

25.0 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.

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

27.0 Consideration

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

27.2 The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL web site.

28.0 **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)
   Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 15 April 2013
c. Price Bid
d. Technical Conditions of Contract (TCC)—Volume-1A
e. Special Conditions of Contract (SCC) —Volume-1B
   Rev. 01 Dt. 01 Jun 2012
f. General Conditions of Contract (GCC) —Volume-1C
   Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 15 April 2013
g. Forms and Procedures —Volume-1D
   Rev. 01 Dt. 01 Jun 2012

For BHARAT HEAVY ELECTRICALS LTD

GM / SCT

Enclosure

1. Annexure-1: Pre Qualifying criteria.
2. Annexure-2: Check List.
3. Annexure-3: Technical criteria
4. Annexure-4 Format
5. Annexure-5 performance
6. Annexure- 6 Tender Schedule
7. Other documents as per this NIT

ANNEXURE – 1

PRE QUALIFYING CRITERIA

JOB	Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre assy., Erection, Testing and Commissioning of HT & LT Electrical Package including Supply & Applications of touch-up, preservation and final painting of above package of 1 X 600 MW – Stage-II of Kakatiya Thermal Power Project, Chelpur, Warangal Dist. AP.
Tender No.:	**BHEL PSSR SCT 1528**

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. **Bidder must fill up this column as per applicability**
A	Submission of Integrity Pact duly signed (if applicable) (Note: To be submitted by Prime Bidder & Consortium/Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder)	Not applicable	
B	**TECHNICAL** Refer Annexure-3	Applicable	To be filled in Annexure-4
C: C-1	**FINANCIAL** **Turnover** Bidders must have achieved an average annual financial turnover (Audited) of **Rs. 1,15,00,000/-** (Rs.One crore fifteen lakhs only) or more over last three Financial Years (FY) i.e 2009-10, 2010-11, 2011-12	Applicable	To be filled in Annexure-4
C-2	**Networth** (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive		To be filled in Annexure-4

C-3	**Profit** Bidder must have earned cash profit in any one of the three Financial Years as applicable in the last three Financial Years defined in 'C-1 above based on latest Audited Accounts.		To be filled in Annexure-4
D	Assessment of Capacity of Bidder to execute the work as per sl no 9 of NIT (if applicable)	Applicable	By BHEL
E	Approval of Customer (if applicable) **Note:** Names of bidders (including consortium/Technical Tie up partners in case consortium bidding is permitted) who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval.	Not Applicable	BY BHEL
F	Price Bid Opening **Note:** Price Bids of only those bidders shall be opened who stand qualified after compliance of criteria A to E	Applicable	BY BHEL
F	Consortium criteria (if applicable)	Not applicable	
	Explanatory Notes for the PQR (unless otherwise specified in the PQR): 1. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as indicated against C-1 above along with all annexures 2. In case audited Financial statements have not been submitted for all the three years as indicated against C-1 above, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years i.e total divided by three. 3. C-2:-NETWORTH: Shall be calculated based on the latest Audited Accounts as furnished for C-1 above. Net worth = Paid up share capital + Reserves. (Net worth is required to be evaluated in case of companies). 4. C-3:- PROFIT: shall be Net profit (PAT + Non cash expenditure viz depreciation) earned during any one of the three financial years as in C-1 above. 5. Void 6. Void		

	7. Void 8. Void 9. Void 10. Void 11. In case the experience/PO/WO certificate enclosed by bidders do not have separate break up prices for the E&C portion of Electrical and CI Works, (i.e. the certificates enclosed are for composite order for supply and erection of Electrical & CI and other works if any), then value of Erection and Commissioning for the Electrical & CI portion shall be considered as 15% of the supply & erection of Electrical & CI, unless otherwise specifically indicated in the PQR. 12. Void 13. Void

BIDDER SHALL SUBMIT PRE-QUALIFICATION CRITERIA FORMAT (Refer Annexure-4), DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK OREDER AND WORK COMPLETION CERTIFICATE ETC 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. No column should be left blank

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: Please tick (√) whichever applicable:- 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** (ANNEXURE-I) is understood and filled with proper supporting documents referenced in the specified format		Applicable	YES / NO
7	Submission of audited profit and Loss Account for the last three years		Applicable	YES / NO

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

NOTE: STRIKE OFF ‘YES’ OR ‘NO’, AS APPLICABLE

Date:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal

ANNEXURE – 3

Technical Criteria

B.A.1 Bidder should have completed

One (1) Electrical work of value not less than Rs. 3,10,00,000/- (Rs.Three crores ten lakhs only) in a Power / Industrial projects in the last seven years reckoned from the date of bid opening.

(OR)

Two (2) Electrical works each of value not less than Rs. 1,96,00,000/- (Rs.One crores ninety six lakhs only) in a Power / Industrial projects in the last seven years reckoned from the date of bid opening

(OR)

Three (3) Electrical works each of value not less than Rs. 1,55,00,000/- (Rs.One crore fifty five lakhs only) in a Power / Industrial projects in the last seven years reckoned from the date of bid opening

AND

B.A.2 Bidder should have executed Erection, testing and commissioning of Electrical works consisting of Power Transformers rating 192 MVA or above, HT Bus Ducts & HT Switch Gears works in a Power Plant in the last seven years reckoned from the date of bid opening

Note: Executed means "Completed the Charging of the Power Transformers rating 192 MVA or above, HT Bus Ducts & HT Switch gears"

Refer explanatory note 11 in Annexure-1 (PQR) for B.A.1 incase of supply involved PO / WO is submitted as qualifying experience.

ANNEURE-4

Format to be submitted by Bidders in a separate booklet and to be submitted in the Envelope-I.

(For Envelope-I, refer Clause 5 of Notice Inviting Tender)

Name of the Bidder: M/s. . . . . .

Sl. No.	PQR Ref	PQR -strikeout whichever is not applicable)	Qualifying Experience	Work order Ref with page no in Offer for supporting documents	Completion certificate ref for the referred Work with page no in Offer for supporting documents	Details of work with Project, Unit, Qty & Period	Remarks
1	**Technical PQR:**						
2	B.A.1	Bidder should have completed One (1) Electrical work of value not less than Rs. 3,10,00,000 in a Power / Industrial projects in the last seven years reckoned from the date of bid opening. (OR) Two (2) Electrical works each of value not less than Rs. 1,96,00,000 in a Power / Industrial projects in the last seven years reckoned from the date of bid opening (OR) Three (3) Electrical works each of value not less than Rs. 1,55,00,000 in a Power / Industrial projects in the last seven years reckoned from the date of bid opening.					

Sl. No.	PQR Ref	PQR -strikeout whichever is not applicable)	Qualifying Experience	Work order Ref with page no in Offer for supporting documents	Completion certificate ref for the referred Work with page no in Offer for supporting documents	Details of work with Project, Unit, Qty & Period	Remarks
3	B.A.2	Bidder should have executed Erection, testing and commissioning of Electrical works consisting of Power Transformers rating 192 MVA or above, HT Bus Ducts & HT Switch Gears works in a Power Plant in the last seven years reckoned from the date of bid opening. **Note**: Executed means "Completed the Charging of the Power Transformers rating 192 MVA or above, HT Bus Ducts & HT Switch gears"					
4	**C:Financial Criteria:**						
5	C1	**<u>Turnover</u>** Bidders must have achieved an average annual financial turnover (Audited) of **Rs. 1,15,00,000/-** (Rs.One crore fifteen lakhs only) or more over last three Financial Years (FY) i.e 2009-10, 2010-11, 2011-12					
6	C2	NETWORTH (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive					

Sl. No.	PQR Ref	PQR -strikeout whichever is not applicable)	Qualifying Experience	Work order Ref with page no in Offer for supporting documents	Completion certificate ref for the referred Work with page no in Offer for supporting documents	Details of work with Project, Unit, Qty & Period	Remarks
7	C3	PROFIT Bidder must have earned cash profit in any one of the three Financial Years as applicable in the last three Financial Years defined in 'C-1 above based on latest Audited Accounts.					
Non submission of this additional format (Annexure-4) will make the bid liable for rejection. (separate sheet for each package to be submitted)							

ANNEURE-5

Tender Schedule

Description	Schedule	Remarks
Technical Bid Opening	As mentioned in Notice Inviting Tender.	
Communication from BHEL for Clarifications, if any, required by BHEL	On or before fifth day of tender opening	
Last date for Bidders to submit the clarifications / documents required	On or before tenth day of tender opening	Bidders to note that their competent representative to be readily available in this week for offering clarifications / submitting the further documents, if any, required.
If Reverse Auction is applicable, then the tentative date for conducting Reverse Auction	Twenty first day of tender opening	Exact date of reverse auction shall be informed to the bidders through BHEL's reverse auction agency. Bidders to note that their competent representative to be readily available at one day notice for Reverse Auction.

Note:

1. Bidders to note that the above schedule should be adhered to and no further extension will be given. To adhere to the schedule indicated below, Bidders should ensure the adequacy of the documents submitted in their offer, with proper validation.

ANNEXURE-6

PERFORMANCE CERTIFICATE

Performance certificate to be submitted by bidders who have not been working with any of the four BHEL Regions in the last 12 months prior to the latest date of bid submission.

Performance of the Agency _____in Project _____

Name of the Agency :
Address of the agency:
Work Order issued :

Erection and Commissioning works in Project _____ under work order dated _____ under reference number / LOI number _____ for the scope of_____ (Copy of work order issued enclosed)

Duration of work as per contract without extended periods : __ months

Time taken for actual completion of works : __ months
(Actual completion of works will mean the completion of contracted works enabling the intended purpose of contract, and not necessarily the closure of contract)

Delays in execution of works attributable to contractor : __ months

Performance of the Contractor in the referred works :

Sl. No	Description of Parameter	Max. Marks	Please enter your score here	Remarks, if any
01	Performance – Technical performance with respect to plan, progress achieved and organization of works at site and HQ	45		
02	Resources – Capacity to plan, organize and utilize the resources like skilled manpower, Tools & Plants(T & P), Consumables	20		
03	Management of Finance for the project	7		
04	Compliance with Safety requirements	10		
05	Compliance with Quality requirements	10		
06	Site infrastructure and services	8		
	Total	100	"X"	

Total score of the Agency _____ in work above is (in words) _____
_____

Signature

Name and Seal of the issuing Authority

Note:

The average marks scored by the bidder in the qualifying works should be above 60% for qualifying the bidder against tendered work.

For Example:

PQR ref B.A.1 / B.B.1 (Annexure-4) :

There is one or two or three projects with score say X_1 , or X_1 & X_2 or X_1 & X_2 & X_3

PQR ref B.A.2 (Annexure-4) :

There is one project with score say x1

The Total score of x1 > 60 is considered as qualified.

Further to this BHEL reserves the right to obtain feedback from customer directly and any adverse report from respective customers on the performance of the bidder will render the bidder liable for rejection.

New vendors (Ref : NIT 9.0 Clause) should enclose the duly filled in certificates for performance as per the format, vide Annexure-6.

VOLUME – IA
Part I & II
TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

CONTENTS

VOLUME-IA PART – I CHAPTER – I
PROJECT INFORMATION

Volume 1A Part-1 Chapter -I PROJECT INFORMATION
KAKATIYA THERMAL POWER PROJECT

1	Name of the Project	Kakatiya Thermal Power Project
2	Station Capacity	1 x 600 MW (Coal based)
3	Owner	Andhra Pradesh Power Generation Corporation Limited **(APGENCO)**
4	Consultant	M/s DESEIN
5	Site Location	Chelpur Village, Ghanur Mandal, Warangal District (½ Km from State High way) and 10 Km from Bhoopalapally
6	Latitude	18 23” N
7	Longitude	79 51”E
8	MSL	180 M
9	Nearest Highway	SH-7 (Connecting Parkal with Mahadevpur)
10	Nearest Town / City	Warangal 65 Kms South East
11	Nearest Railway Station	1. Uppal Railway station on SCR & 45 Kms from site 2. Warangal Railway station of SCR 65 Kms from Site
12	Nearest Air port	240 Kms (Hyderabad)
13	Metrological Data	
	A) Temperature	
	i. Average Max Temperature	34.5 Deg C
	ii. Average Min Temperature	22.3 Deg C
	iii. Highest Max	45.7 Deg C

	Temperature	
	iv. Lowest Minimum Temperature	9.0 Deg C
	v. Temperature to be considered for design of Electrical Equipments / Devices	50 Deg C
	B) Relative Humidity average	55%
	C) Rainfall (Average Annual)	1005 mm
	D) Wind Data / Basic Speed	47 M / Sec
	E) Seismic Data	Zone II
14	Languages spoken in the region	English, Telugu
15	Language for communication with Sub-Contractor / Vendors	English
16	Tropicalisation	All Equipments supplied against this specification shall be given tropical and fungicidal treatment in view of climatic conditions prevailing at site
17	Supply Voltage	240 V AC for Lighting

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

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

SCOPE OF WORKS – HT Electrical

1.2.0 SCOPE OF WORK IN GENERAL:

1.2.1 Scope of Electrical work covered in this tender are Transformers (all types), HT Switchgears (11/6.6) KV), HT Bus Ducts, Generator Control Panel and commissioning of HT Drives, Start up control Panels, etc.

1.2.2 The scope of work covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing and commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, PVC sleeves for wire marking, lugs (specific sizes), specific type of fasteners, paints and its consumables. Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (except proprietary type instruments), returning of un-used materials / items to BHEL stores.

1.23. It is not the intent to specify herein all details of material. Any item related to this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.2.4 The scope of specification covers the installation, testing and commissioning of the following electrical equipments, hardware along with accessories as detailed in Bill of Materials

1.2.5 If any item or equipment not covered but requires to be erected / commissioned, the same shall be carried out by the contractor. Equivalent unit rate for those item or equipment shall be considered wherever possible from the BOM. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

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

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

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

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

1.2.6.3 Supply of consumables as per clause 1.3.6 &1.2.2

1.2.6.4 Final painting including supply of paints.

Note:

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

SCOPE OF WORKS- LT Electrical

1.2.7 SCOPE OF WORK IN GENERAL:

a) *Scope of Electrical works covered in this tender are as follows:*
b) *Erection and commissioning of Battery & battery charger panels.*
c) *Erection and commissioning of LT MCC, AC / DC Distribution Boards, Starter Panels, etc.*
d) *Erection and commissioning of LT Bus Ducts.*
e) *Erection and commissioning of Control Panels*
f) *Erection of Trays & accessories and Trays supports.*
g) *Installation of local push button stations, local starter, Junction Boxes etc.*
h) *Laying and termination of LT cables including supply of ferrules, tag plates, and cable dressing materials as detailed in scope of cabling.*
i) *Installation of above ground earthing grid, earthing of equipment / cable racks / trays etc. as applicable.*
j) *Installation of Lightning protection*
k) *Fabrication and installation of steel supports wherever required.*
l) *Commissioning of LT-drives and electrically operated equipment erected by Mechanical contractor.*
m) *Installation of other items that have not been specifically indicated, but required for completing installation.*
n) *Supply of paints and painting of items covered in the scope of works*.

1.2.8 GENERAL

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

a) *Identification of equipment at storage yard, technical assistance for checking and making the shortage / damage reports, taking delivery at storage yard / stores and pre-assembly of equipment wherever required, erecting, checking, carrying out statutory tests as required, pre-commissioning, commissioning & post-commissioning activities up to trial operation of the unit and handing over to customer or till completion of contract period whichever is earlier, along with the supply of all consumables, tools and tackles, testing instruments. The installation and*

commissioning of all the electrical equipments / items shall conform to the technical requirements specified elsewhere in the tender.

b) *It is not the intent to specify herein all details of material. Any item related to this work not covered, but necessary to complete the system will be deemed to have been included in the scope of the work.*

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

d) *Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.*

e) *Supply of paints and consumables as per clause 1.3.6 & 1.2.7 (n)*

f) *Final painting including supply of paints.*

Note:

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

VOLUME-IA PART – I CHAPTER – III

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

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

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
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:	Yes		**Free of charge** basis
1.3.1.3.1.1	Making the water available at single point	Yes		
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	
1.3.1.4	**LIGHTING**			

Sl.No	Description PART I	Scope to be taken care by BHEL	 Bidder	Remarks
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 PART II	Scope to be taken care by BHEL	 Bidder	Remarks
	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
1.3.2.1.3	As-built drawings – wherever deviations observed and executed and also based on	Yes	Yes	,,

Sl.No	Description PART II	Scope to be taken care by		Remarks
		BHEL	Bidder	
	the decisions taken at site- example – routing of small bore pipes, cable schedule & wiring diagrams			
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 Sl No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily erection / work plan based on Sl 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 The construction power will be provided on **free of charge basis** a single point and the further distribution with necessary isolator / LCB etc. to be arranged by the bidder at his cost. The required energy meter for measuring power consumption will be installed by the contractor and it is for calculation purpose. Any dispute regarding consumption, the BHEL engineer decision is final.

Contractor shall make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure. No separate payment shall be made for this contingency

1.3.4.2 Necessary "Capacitor Banks" to improve the Power factor (0.8) 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.

1.3.4.3 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.

1.3.4.4 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.

1.3.4.5 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 for construction purpose shall be provided by **BHEL free of charge at one single point.** Further distribution shall be arranged by the contractor at his cost
No separate payment shall be made for any contingency arrangement made by contractor for construction water. Contractor has to make his own arrangements for his water requirement for 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, filler wires, Gases 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 Insulation tape.

3 Paints required for primer coating & final coating and for protective coating.Paint of approved colour, Consumables like thinner, brushes, emery paper etc.

4 Solder wire (Lead) -(60/40)

5 Protocol/Calibration report sheets as per BHEL Format.

6 PVC wire marker sleeves and tag plates.

7 Panel / JB Sealing compound material (for cable entry from bottom/Top of Panel).

8 Materials required for cable dressing (PVC cable tie, Aluminium or GI flats etc.)

9 Anchor fasteners for wall mounted cable trays & JBs

VOLUME-IA PART – I CHAPTER – IV

T&Ps and MMEs TO BE DEPLOYED BY CONTRACTOR per package

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 Oil Filtration and tank with 5 to 6 Kl / hr. capacity :1No

1.4.2 Oil Filtration and tank with 1 to 1.5 Kl / hr. capacity :1No

1.4.3 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.

EQUIPMENT FOR TESTING & COMMISSIONING:

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

i) Insulation tester :
a) Motorised megger - 0 - 1000 - 2000 - 5000V, 0 - 25000 M ohms
b) Hand operated megger - 0.5 KV/1.0 KV/2.5 KV, 0- 1000 M Ohms

ii) Earth resistance tester 0 to 1, 10, 100 ohms

iii) Transformer oil test kit

iv) Torque wrench

v) Voltmeter ac 0 - 125 - 250 - 625 V ac

vi) Ammeter ac 0 - 2A - 10A ac.

vii) Wattmeter - ac/dc - 0 - 125 - 250 V 0-5-10A.

viii) Multimeter - analogue :acV 2.5V - 2500V, ac A - 100 mA - 10 A
dc V 25.V - 2500V, dc A - 50mA - 10A
Resistance - 0 - 200 M ohms
digital : voltages ac & dc - 100mv - 1000 V
current 10-mA - 10A Resistance - 0-20 M ohms

ix) High vacuum stream line oil filter of 5 to 6 KL/hr (1 no) and 1KL/Hr for transformer dryout.

x) Variac - 1 /3 phase - 5A, 15A 3 phase - 10A, 20A.

xi) Primary injection kit - 0-10000 A.

xii) Secondary injection kit - 0-5A.

xiii) HV Test kit - 50 KV AC 400kVA.

xiv) Wheat stone bridge - 0.05 m ohm - 100 ohm.

xv) Oscilloscope
xvi) Air compressor.
xvii) Oil Tank for transformer oil filtration
xviii) Vacuum pump.
xix) Phase sequence meter - 110V - 450V - 25 to 65Hz.
xx) Frequency meter - 0 - 115 - 230 - 4500 - 45 - 601/s.
xxi) Tong tester - 0 - 5A - 10A, 30A, 60A, 150A - 600A, 500A-1000A.
xxii) Tachometer etc.
xxiii) SF6 filling and evacuating equipment.
xxiv) mA Source
xxv) Standard pressure gauges – If required
xxvi) Temperature oil bath– If required
xxvii) Tan Delta Test kit- Only if HV transformers are included in rate schedule
xxviii) Oil specific gravity and PPM measuring equipment- Only if HV transformers are included in rate schedule
xxix) Dew point measurement instrument –If required
xxx) 3 phase relay testing kit (Of type omicron etc) To be brought when required
xxxi) Contact resistance measurement kit
xxxii) Micro Ohm meter

1.4.5 ACCURACY REQUIREMENT OF TESTING INSTRUMENTS

SINo	***INSTRUMENT / TOOL***	***RANGE***	***ACCURACY***
1	*Power Pack*	*0 to 50V DC, 3A*	*± 2%*
2	*Analog Multimeter*	*Voltage 2.5 to 2500V AC*	*± 1.0%*
		Current 100 mA to 10A AC	*± 2.0%*
		Current 250 micro A to 1A DC	*± 1.5%*
		Resistance upto 100 ohms	*± 3.0%*
		Voltage 2.5V to 2500V DC	*± 1%*
3	*Digital Multimeter*	*Voltage 200mV to 1000 V DC*	*± 1% + 1 digit*
		Philips Voltage 200mV to 1000 V AC	*± 1% + 1 digit*
		Hcl Current 200mA to 20 A AC	*± 0.8% + 1 digit*
		Philips Current 20 mA to 20 A AC	*± 0.8% + 1 digit*

SINo	INSTRUMENT / TOOL	RANGE	ACCURACY
		Resistance (Hcl) 2120 200* to 200M*	± 0.5% + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 1 digit
		Hcl Voltage 200mA to 750 V	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A DC	± 0.5% + 1 digit
		Hcl Current 200 mA to 010 A AC	± 1% + 1 digit
4	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	± 0.5% mm/sec
		Displacement upto 300 microns	± 2 microns
5	Secondary Injection Kit	Upto 5A	± 0.5mA
6	Motor operated Megger	Upto 200 Ohms	± 5% at Centre scale
7	Tongue tester	0/300/600A AC	± 5%
		0 to 300A DC	± 5%
8	Tachometer (Hand held)	0 to 4000 rpm	± 5%
9	Phase Sequence Meter		N/A
10	Three Phase Variac	15 A Capacity	N/A
11	Feeler gauges	300 mm long and 100 mm long	± 2 microns
12	Dial gauges	0 to10mm	± 0.01 mm
13	Hand operated Megger 500V / 1000V/2.5 KV	Upto 1000 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
14	Motorised Megger 2.5 KV	Upto 1000 M Ohms	± 5% at Centre Scale ± 10% at end of Scale
15	Earth Resistance tester (Tester)	0 to 1, 10 Ohms	± 5% at Centre Scale range
16	AC tongue Tester	0 to 1000A AC	± 3%
17	DC Tongue Tester	0 to 300A DC	± 5%
18	High Voltage test Kit	Upto 50 KV AC -50 ma capacity	± 10%
		Upto 70 KV DC	± 10%
19	DC Ammeter	0 to 300 A	± 10%

SINo	INSTRUMENT / TOOL	RANGE	ACCURACY
20	DC Voltmeter	0 to 500 V	± 10%
21	Micro ohm meter	10A and 100 A	
22	Primary Injection Kit	0-10000A	
23	Single Phase Variac	0-15 Amps	
24	Motor direction tester		
25	DC Tong Tester (mA)	0-500 mA	
26	Contact resistance tester for breaker contact resistance measurement		
27	Motorised Megger 5 KV	10000 M ohms	

NOTE:

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.*

2. Note for Contractors' Instruments

a. *The contractor shall arrange all the above T&P, equipment and instruments as indicated except testing instruments which are proprietary in nature.*

b. *The contractor at his cost shall arrange all cranes and truck / tractor, trailers required for material handling purpose and also cranes required for erection. If contractor requires any equipments other than what is mentioned as free issues from BHEL same can be hired from BHEL on chargeable basis subject to availability.*

c. *Any other tools and plants instruments and equipment required in addition to the above for the successful completion of this job will have to be arranged by the contractor at his cost.*

d. *Necessary accessories for the above shall also be provided by the contractor.*

e. *The above instruments / equipment will be sent for testing and calibration wherever from time to time and maintained by contractor as required by BHEL.*

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

g. *List of such agencies and periodicity of calibration required for different instruments will be furnished by BHEL at site.*

h. Contractor shall maintain calibration records as per the BHEL format and produce them whenever called for by BHEL Engineers.

i. Contractors shall arrange experienced/qualified persons for using these calibration instruments at laboratory and also at work spot.

j. Wherever frequent calibration is required, contractor shall arrange adequate number of instruments such that the work does not suffer for want of test instruments.

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

1.4.6.1 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.

1.4.6.2 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.

1.4.6.3 No material or equipment or tools etc. shall be taken out of the work-site without the written consent of BHEL.

1.4.6.4 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.

1.4.6.5 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.

VOLUME-IA PART – I CHAPTER - V

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

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

S. No	*Description*	*Quantity*
01	*Crane- 75 T capacity*	*01 No*
02	*EOT Crane*	*01 No*

Note:

1. *BHEL will provide 75 Ton capacity sharing basis at free of hire charges*
2. *BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL. Operator for the BHEL cranes excluding EOT crane will be provided by BHEL on free of charges.*
   a) *In the event of providing BHEL Cranes:*
      Fuel has to be arranged by the bidder at their cost
   b) *In the event of providing hired cranes:*
      The fuel charges shall be recovered as given below:
      (i) For 75 T crane: Rs. 120/hr
      (ii) For 150 T/ 135 T/100T crane: Rs 200 /hr
3. *Subject to availability, BHEL shall provide EOT crane for the purpose of shifting the panels with in PH building on sharing basis at free of hire charges. However Operator shall be arranged by the contractor.*
4. *Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipments, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.*
5. *All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at his cost.*
6. *75T Crane is only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.*
7. *The availability of cranes is likely to be hampered from time to time due to routine preventive maintenance or breakdown maintenance. Contractor has to make*

alternative arrangement or plan / modify / alter his activities to suit the above conditions and the contractor will not be liable for any compensation or extension of time due to this non availability, for maintaining the erection schedule.

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.

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 **15 (Fifteen) months** from the date of commencement of work at site work.

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 COMMISSIOING 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:-

DESCRIPTION	**MILESTONE MONTH for Package**
Start of work **(Expected)**	JUNE 2013
Boiler Light Up	4th month
Barring gear	9th month
Synchronisation	11th month
Full load / Trial Operation	14th month
Handing over	15th 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 & 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**15 (Fifteen) months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work for each package.

1.6.6 GUARANTEE PERIOD

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).

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 1.7.1.10.4 of the following table.

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

Sl. No.	Activity / Work Description	% of unit rate
1.7.1.5	**DG sets / Switch Gears / MCC / PCC / Distribution Boards / Marshalling Box / Starter Units / Dry Transformers / Electrical Hoists/ Panels / Cubicles / Desks / UPS / Batteries / Chargers / VFD / LA assy / NGT / NGR / SP/ Circuit breaker/ Miscellaneous Equipment/ etc**	
1.7.1.5.1	Placement, Alignment and coupling / interconnection where ever applicable, erection of associated accessories etc	50%
1.7.1.5.2	Pre-commissioning checks and tests	10%
1.7.1.5.3	Charging, Loop testing and commissioning	15%
1.7.1.5.4	System commissioning	10%
	Total =	**85%**
1.7.1.6	**Earthing / Lightning protection strips, Earthing pits**	
1.7.1.6.1	Fabrication, erection, alignment, welding / bolting of earthing / lightning protection strips; earth pits Completion	60%
1.7.1.6.2	Testing / commissioning	25%
	Total =	**85%**
1.7.1.7	**LT / HT Bus Ducts**	
1.7.1.7.1	Pre assembly of Bus Ducts and accessories, erection, alignment, bolting/welding etc complete with supporting structure	50%
1.7.1.7.2	Pre commissioning checks	20%
1.7.1.7.3	Testing, Charging and Painting (as applicable)	15%
	Total =	**85%**
1.7.1.8	**Oil Filled Transformers (Generator, Station, UAT, Standby etc)**	
1.7.1.8.1	Placement on foundation and alignment	25%
1.7.1.8.2	Erection of associated auxiliaries / assemblies, oil filling, etc	25%
1.7.1.8.3	Dry out including oil filtration	15%
1.7.1.8.4	Pre-commissioning checks	10%
1.7.1.8.5	Testing, Charging and Painting (as applicable)	10%
	Total =	**85%**
1.7.1.9	**Testing / Commissioning of Equipment (like motors, actuators, ESP transformer, misc equipments, etc) erected by other agencies**	
1.7.1.9.1	Local testing (Including oil filtration for ESP transformers)	40%
1.7.1.9.2	Remote testing, Loop testing, and commissioning	40%

Sl. No.	Activity / Work Description	% of unit rate
1.7.1.9.3	System commissioning	5%
	Total =	**85%**
1.7.1.10	**Other items**	
1.7.1.10.1	Rubber mats / Display Boards / Miscellaneous items / etc : on installation	85%
1.7.1.10.2	Specialised Commissioning Services - on pro rata basis.	85%
1.7.1.10.3	Civil Works / structural works - Prorata on completion of actual work.	85%
1.7.1.10.4	Termination, HT Termination, Straight through jointing etc : on pro rata basis	85%

1.7.2 Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events for the **erected items** as mentioned in Clause no 1.7.2 of the following table.

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

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.

1.7.3 PROVIDENT FUND & MINIMUM WAGES

1.7.3.1 The contractor is required to extent the benefit of Provident Fund to the labour employed by you in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, you are hereby required to get yourself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to you by the Provident Fund authorities within one month from the date of issue of this letter of intent. Incase you are exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of your failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to us by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to you.

1.7.3.2 The contractor shall ensure the payments of minimum labour wages to the workmen under him as per the rules applicable from time to time in the state.

1.7.3.3 The final bill amount would be released only on production of clearance certificate from PF/ESI and labour authorities as applicable.

1.7.4 OTHER STATUTORY REQUIREMENTS

1) The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no alongwith the **first** running bill.

2) The contactor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

3) The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. Incase of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

4) The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under I D Act 1948, copies of Form 6-A(Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act1948 (If applicable) to BHEL along with the Final Bill.

5) In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

6) In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

7) In addition to the clause 2.8 of General Conditions of Contract (Vol-1C of Book II) the contractor shall comply with the following.

7.1 The Contractor should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice Of Commencement /Completion of Building other Construction Work) to the respective Labour Authorities i.e.,

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt. – NTPC, NTPL etc

b) Inspector of Factories in respect of the project premises which is under the purview of State Govt.

7.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL

7.3 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc

7.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

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.

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.

VOLUME-IA PART – I CHAPTER - IX
BILL OF QUANTITY (BOQ)
KAKATIYA 1X600MW, STAGE – II

Erection and Testing Commissioning of HT& LT Electrical Package		
Bill of Materials (BOM) contains detailed specification of various instruments and items, BHEL Unit wise and system-wise		
SL.No	***Description***	**Qty**
A.0	***BHEL BHOPAL SCOPE***	
A.1.0	***TRANSFORMER***	
A.1.1	***GENERATOR TRANSFORMER - 240 MVA*** *240 MVA, 400/√3/21 kV, 1 phase, OFAF/ONAF/ONAN cooled, Generator Transformer complete with loose accessories like coolers with fans, on load tap changers, HV/LV/HVN bushings, bushing CTs, Turrets, Conservator tank, Cooler control cabinet, Piping, etc.* *Loose items like facia windows, W.T.I. repeaters, buzzers, signal lamps, etc. shall be mounted and wired in control panel.* *Complete erection and integration of neutral formation (HV side only)for R, Y, B phases & grounding, including fixing of porcelain insulators and conductors (copper bars), brazing of joints, painting of supports, repair of damaged surface, protection at brazed areas of copper bar, connection to ground grid etc., shall also be part of transformer erection.* ***Accessories:*** *PRV-2 Nos., Drain valve-2 Nos., Cooler control cabinet ,inlet valve-02 Nos., & out let valve-1 No., 36kv post insulator-4 Nos..* ***Conservator:*** *Main conservator tank with air cell, Buchholz relay, breather & connected pipe lines* ***Cooling system :*** *OFAF Cooler, Radiator assembly-32., A- Frame support for Header -4 Nos., Fan motor – 14 Nos., Oil pump& motor - 4Nos, Pipe supports-6 Nos., ., OFI-4 Nos., Valves.* ***Turret and bushing :*** *HV line & neutral bushing 01 each, LV bushing –2, HV&LV turret –1each, Neutral turret-1, on line GMS-1No.,* ***OFF Circuit Tap changer*** *–1set (+/-10% in steps of 2.5 %).* *Approximate Dimensions of each transformer (l x b x h)* *Shipping dimensions 7250 x 3880 x 4600 mm* *Overall dimensions 15100 x 7000x 10800 mm*	*4 sets**

	Weight of Transformer Components *Weight of Largest Package - 192000 Kg approx.*	
	Weight of core and winding assembly-166400 Kg approx. *Weight of tank and fittings, bushing, marshalling box, pipe work with supports, pump, conservator & coolers – 75470 Kg approx.* *Total Oil - 57420 Kg approx.* *Total weight of the Package - 299290 Kg approx.* *Total Oil Quantity - 66000 Ltrs. approx.* ** Lump sum rate to be quoted including final painting*	
A.2.0	***HT SWITCHGEAR***	
A.2.1	***11 KV Unit Switchboard - 2BA***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2000A incomer-1 No, 630 A outgoing feeders - 12 nos, 1000A Outgoing feeder – 1No., 2000A tie feeder from 11KV Station SWBD OBA - 1 No , Bus PT Cubicle- 1 No along with associated loose supplied items. *2BA consists of 16 panels of suitable shipping sections* *Each Panel Size - 820(W)x2355(D)x 2692(H) mm* *Weight of Shipping section for 1 Panel: 1500 kg approx.* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1 set**
A.2.2	***11 KV Unit Switchboard - 2BB***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2000A incomer-1 No, 630 A outgoing feeders - 12 nos, 1000 A Outgoing feeder – 1No.,2000 A tie feeder from 11KV Station SWBD OBB - 1 No , Bus PT Cubicle- 1 No along with associated loose supplied items. *2BB consists of 16 panels of suitable shipping sections* *Each Panel Size - 820(W)x2355(D)x 2692(H) mm* *Weight of Shipping section for 1 Panel: 1500 kg approx.* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1 set**
A.2.3	***11 KV Station Switchboard - OBA***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2750A incomer-1 No, 1000 A outgoing feeders - 6 nos, 630A outgoing feeders -9 Nos, 2000 A tie feeder to 11KV Unit SWBD 2BA - 1 No , 2500 A tie feeder to 11KV Station SWBD OBX-2- 1 No, Bus PT Cubicle- 1 No along with associated loose supplied items. *OBA consists of 18 panels of suitable shipping sections* *Each Panel Size - 820(W)x2651(D)x 2692(H) mm* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1 set**

A.2.4	***11 KV Station Switchboard - OBB***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2500A incomer-1 No, 1000A outgoing feeder - 3 nos, 630A outgoing feeders -9 Nos, 2000 A tie feeder to 11KV Unit SWBD 2BB - 1 No., 2500 A tie feeder to 11KV Station SWBD OBX2- 1 No., Bus PT Cubicle-1 No. along with associated loose supplied items. *OBB consists of 16 panels of suitable shipping sections* *Each Panel Size - 820(W)x2355(D)x 2692(H) mm* *Weight of Shipping section for 1 Panel: 1500 kg approx.* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1set**
A.2.5	***11KV Station Switchboard – OBX-1***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2750A tie feeder fed by Bus duct to Station SWBD OBX2-1No., 2500A tie feeder – 1No., OBX-1 consists of 2 panels of suitable shipping sections *Each Panel Size - 820(W)x2355(D)x 2692(H) mm* *Weight of Shipping section for 1 Panel: 1500 kg approx.* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1 set**
A.2.6	***11KV Station Switchboard – OBX-2***	
	11 KV, indoor, metal clad, vacuum break switchgears with 2750A tie feeder fed by Bus duct to Station SWBD OBX1-1No., 2500A tie feeder fed by Bus duct to Station SWBD OBB-1No., 2500A tie feeder fed by Bus duct to Station SWBD OBA-1No., 2500A tie feeder – 1No., Bus PT Cubicle -1No.along with associated loose items.. *OBX-2 consists of 5 panels of suitable shipping sections* *Each Panel Size - 820(W)x2355(D)x 2692(H) mm* *Weight of Shipping section for 1 Panel: 1500 kg approx.* *Weight of Shipping section for 2 Panels: 3000 kg approx.* ** Lump sum rate to be quoted.*	*1set**
A 2.7	***3.3 KV Station Switchboard - 0CA***	
	***3.3 KV**, indoor, metal clad, vacuum break switchgears with 3150 A incomer-1 No, 630 A outgoing feeders -4 Nos, 3150A tie feeder-1 No ,Bus PT Cubicle -1 No along with associated loose supplied items.*	*1 set**
	0CA consists of 7 panels of suitable shipping sections	
	Panel Size -820(W)x2651(D)x2692(H) mm	
	Weight of Shipping section for 1 Panel: 1500 kg approx.	
	Weight of Shipping section for 2 Panels: 3000 kg approx.	
	** Lump sum rate to be quoted.*	

A 2.8	***3.3 KV Station Switchboard - 0CB***	1 set*
	***3.3 KV**, indoor, metal clad, vacuum break switchgears with 3150 A incomer-1 No, 630 A outgoing feeders -3 Nos, 3150A tie feeder-1 No ,Bus PT Cubicle -1 No along with associated loose supplied items.*	
	0CB consists of 6 panels of suitable shipping sections	
	Panel Size -820(W)x2651(D)x2692(H) mm	
	Weight of Shipping section for 1 Panel: 1500 kg approx.	
	Weight of Shipping section for 2 Panels: 3000 kg approx.	
	** Lump sum rate to be quoted.*	
A 2.9	***3.3 KV Unit Switchboard - 2CA***	1 set*
	***3.3 KV**, indoor, metal clad, vacuum break switchgears with 3150 A incomer-1 No, 630 A outgoing feeders -14 Nos, 3150A Tie feeder-1 No ,Bus PT Cubicle -1 No, along with associated loose supplied items.*	
	2CA consists of 17 panels of suitable shipping sections	
	Panel Size -820(W)x2651(D)x2692(H) mm	
	Weight of Shipping section for 1 Panel: 1500 kg approx.	
	Weight of Shipping section for 2 Panels: 3000 kg approx.	
	** Lump sum rate to be quoted.*	
A.3.0	***GENERATOR , GT & UT CONTROL / PROTECTION & METERING PANELS***	
A.3.1	***Generator Relay Panel***	1 set*
	Generator Relay Panel with associated loose supplied items such as PC, Printer, UPS, interconnecting cables etc. *No. of Panels: 4 Nos. supplied in suitable shipping sections.* *Size of each Panel: 1000 (w) x 1000 (d) x 2230 (h) mm* *Approximate weight of each panel : 600 kg* ** Lump sum rate to be quoted.*	
A.3.2	***BUS TRANSFER PANEL***	2 set*
	Bus transfer panel with associated loose items supplied such as Laptop etc. *Approximate dimensions : 800(w) x 800(d)x2355(h) mm* *Weight : 300 kg approx.* ** Lump sum rate to be quoted.*	
A.4.0	***EARTHING TRUCK / BREAKERS***	
	Approximate dimensions : 600(W) x 860(D)x1280(H) mm *Weight : 400 kg approx each*	
	Feeder & Busbar earthing truck- 11 KV	6 Nos.
	Feeder & Bus bar earthing truck- 3.3 KV	3 Nos
B.0	***BHEL JHANSI SCOPE***	
B.1.0	***TRANSFORMERS***	
B.1.1	***UNIT TRANSFORMER***	2 sets*

	31.5 MVA, 21KV/11.5KV, ONAN/ ONAF, 3 Phase, Unit Transformer with HV/LV/LVN Porcelain bushings, Marshalling Box, Main conservator, Aux.conservator for OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators with Fans, On load tap changer on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , 11 KV NGR with supporting stand, etc. *<u>Approximate dimensions (LxBxH)</u>* *Overall dimensions : 9200 x 5100 x6700mm* *Shipping Dimension of Largest package:4800x3500x3700 mm* *Weight of heaviest package- 45000 Kg approx.* *Total weight- 82000 Kg approx.* *Oil Qty- 28000 Ltrs. approx.* ** Lump sum rate to be quoted including final painting.*	
B.1.2	***80 MVA STATION TRANSFORMER*** *80 MVA, 400/11.5-11.5KV, ONAN/ ONAF/OFAF, 3 Phase, Unit Transformer with HV/LV/LVN Porcelain bushings, Marshalling Box, Main conservator, Aux. conservator for OLTC, A-frame supports for radiator, Silica gel breather with oil seal, rollers, Radiators with Fans, On load tap changer on HV side, Buchholz relay, PRV, Shut off valve between Buchholz relay and conservator, Piping , 11 KV NGR with supporting stand, etc.* *<u>Approximate dimensions (LxBxH)</u>* *Overall dimensions : 16500 x 7400 x 9600 mm* *Shipping Dimension of Largest package:7860x3750x4290 mm* *Weight of heaviest package- 90000 Kg approx.* *Total weight- 153000 Kg approx.* *Oil Qty- 47100 Ltrs. approx.* ** Lump sum rate to be quoted including final painting.*	*1 set**
B.1.3	***UNIT AUX. TRANSFOMER*** *16 MVA, 11/3.6 KV, ONAN/ONAF, 3 phase, Unit Aux. Transformer with off load tap changer on H.V Side, HV/LV/LVN Porcelain bushings, radiators, conservator, marshalling panel, HV Cable box with disconnecting chamber, Buchholz relay, Cable box supports, PRV, piping, 3.6 KV NGR with supporting stand, etc.* *<u>Approximate Dimensions</u> (l x b x h)* *Overall dimensions : 7100 x 5800 x 5400 mm* *Shipping dimension of Largest Package : 4900 x 2500 x 2900 mm* *Oil - 13400 ltrs approx.* *Weight of heaviest package - 30200 Kg (approx.)* *Total Weight - 44600 Kg. approx.* ** Lump sum rate to be quoted including final painting.*	*2 sets**

B 1.4	***STATION AUX. TRANSFOMER***	
	16 MVA, 11/3.6 KV, ONAN/ONAF, 3 phase, Station Aux. Transformer with off load tap changer on H.V Side, HV/LV/LVN Porcelain bushings, radiators, conservator, marshalling panel, HV Cable box with disconnecting chamber, Buchholz relay, Cable box supports, PRV, piping, 3.6 KV NGR with supporting stand, etc.	
	Approximate Dimensions (l x b x h)	*2 sets**
	Overall dimensions : 7100 x 5800 x 5400 mm	
	Shipping dimension of Largest Package : 4900 x 2500 x 2900 mm	
	Oil - 13400 ltrs. (approx).	
	Weight of heaviest package - 30200 Kg approx.	
	Total Weight - 44600 Kg. approx.	
	** Lump sum rate to be quoted including final painting.*	
C.0	***BHEL RUDRAPUR SCOPE***	
C.1.0	***BUSDUCT :***	
C.1.1	***21 KV IP BUSDUCT***	
	21 KV IP Busduct** along with support structures, SPVT cubicle, NG cubicle and other loose supplied items such as Seal off bushings, CTs, Lightning arrestor, Hot Air Blowing equipment, flexible hoses from HAB system to bus duct, control cabinet for HAB, Conduiting and wiring for space heaters, illumination, etc., CT/PT wiring and conduiting, erection of JBs etc. comprising of the following:* a) *22000 A IP Bus duct from 600 MW Generator to 3x240 MVA Single phase generator transformers, with -22000A main run Bus duct* b) *13000 A Delta Run Bus duct* c) *2000 A tap off bus ducts to Unit Transformer* ***Dimensions and Weights *a) Approx. Total BD length of all types : **441** Mtrs (Main,Delta,Tapoff,LAVT,NG)* *b) Approx. Length of main busduct at Neutral side of all phases: 180 Mtrs* *c) Shape and size of main bus bar :Cylindrical 16TKx800 O/D* *d) Shape and size of Tap off bus bar: 2x203.2x65.02x11.84 channel(Box formation)* *e) Shape and size of Delta bus bar: Cylindrical 15TKx450 O/D* *f) Approx. Weight of busduct (Main,Tap-off, Delta Connection) - 100MT*	*1 set**

	g) Shape and size of main busduct enclosure: Cylindrical 1600 O/D, 8 TK *h) Shape and size of Tap off bus duct enclosure: Cylindrical 876 O/D,4.78 TK* *i)Shape and size of Delta bus duct enclosure: Cylindrical 1070 O/D, 6.35 TK* *j) Hot Air Blowing Equipment :- Size 4800x3750x2250 mm, weight 1 ton approx.* *k) NG (NGR-NGT) Cubicle:2200x1600x2135 mm, 1750 kg (approx.)* *l) SPVT Cubicle: 3 Nos., each of size 800x2250x2835 mm and weight 1400 kg each (Approx)* *m) Weight of support Structure: 65 MT for each unit (approx.)* ** Lump sum rate to be quoted including final painting.*	
C.2.0	***11 KV SP Busducts***	
	The SP Busducts will be supplied along with support structures and other loose supplied items like Splice Plate, Seal off Bushings, flexibles, Rubber bellows, etc. Work includes mounting of space heaters, Breather, laying of Conduit and fixing , wiring for space heaters, providing support and erection of overall enclosure with proper support etc.	
C.2.1	*11KV, 3150 A, SP Bus duct from unit transformer-2A to11KV Switchgear 2BA(size of Busduct 450mmx1350mm approx.), 2000 A*	*136 Mtrs.*
	11KV, 3150 A, SP Bus duct from unit transformer-2B to 11KV Switchgear 2BB (size of Bus duct 450mmx1350mm approx.), 2000 A	*138 Mtrs*
C.2.2	*11KV, 3150 A, SP Bus duct from station transformer-LV1 to 11KV Switchgear OBA-1(size of Bus duct 450mmx1350mm approx.), 2750 A*	*50 Mtrs*
	11KV, 3150 A, SP Bus duct from station transformer-LV2 to 11KV Switchgear OBB (size of Bus duct 450mmx1350mm approx.), 2500 A	*65 Mtrs*
C.2.3	*3.3 KV, 3150A, SP Bus duct from Unit Aux. Transformer 2CAT01 to 3.3 KV Switchgear 2CA-17(size of Bus duct 450mmx1350mm approx.), 3150 A*	*37 Mtrs*
	3.3 KV, 3150A, SP Bus duct from Unit Aux. Transformer 2CBT01 to 3.3 KV Switchgear 2CB-18(size of Bus duct 450mmx1350mm approx.), 3150 A	*39 Mtrs*
C.2.4	*3.3KV, 3150A, SP Bus duct from Station Aux. Transformer OCAT01 to 3.3 KV Switchgear OCA-4(size of Bus duct 450mmx1350mm approx.), 3150 A*	*54 Mtrs*

	3.3KV, 3150A, SP Bus duct from Station Aux. Transformer OCBT01 to 3.3 KV Switchgear OCB-2(size of Bus duct 450mmx1350mm approx.), 3150 A	*59 Mtrs*
C.2.5	*TIE Busduct – 11KV Switchgear From 2BA-5 to OBA-5(size of Bus duct 450mmx1350mm approx.), 2000 A*	*13 Mtrs*
	TIE Busduct – 11KV Switchgear From 2BB-8 to OBB-7(size of Bus duct 450mmx1350mm approx.), 2000 A	*13 Mtrs*
C.2.6	*TIE Busduct – 3.3 KV Switchgear From 2CA-1 to OCA-7(size of Bus duct 450mmx1350mm approx.), 3150 A*	9 Mtrs
	TIE Busduct – 11KV Switchgear From OBX-2-5 to OBA-18(size of Bus duct 450mmx1350mm approx.), 2500 A	20 Mtrs
C.2.7	*TIE Busduct – 11KV Switchgear From OBX-2-1 to OBB-15(size of Bus duct 450mmx1350mm approx.), 2500 A*	6 Mtrs
	TIE Busduct – 3.3 KV Switchgear From 2CB-1 to OCB-6(size of Bus duct 450mmx1350mm approx.), 3150 A	10 Mtrs
C 2.8	*TIE Busduct – 11KV Switchgear From OBX-1-8 to OBX-II-3(size of Bus duct 450mmx1350mm approx.), 2750 A*	216 Mtrs
	Approximate Total Weight of support structure for 60 MT *Approximate Weight of BD : 100Kg/mtr*	
D.0	***BHEL EDN SCOPE***	
D.1.0	***EXCITATION EQUIPMENTS***	
D.1.1	***DIGITAL AUTOMATIC VOLTAGE REGULATOR***	
	Digital AVR consisting of 1 No. Regulation cubicle, 2 Nos. Thyristor cubicle , 1 No. surge suppression cubicle, along with associated loose supplied items. *Overall dimension: 4500x 1200 x 2650 mm,* *Approximate wt : 3600 Kg.* ** Lump sum rate to be quoted.*	*1 set**
D.2.0	***VFD FOR ID FANS***	
D.2.1	***VFD Transformer***	
	4600 KVA, 11/4.1 KV, 3 Phase, ONAN, Outdoor type, Dry type transformer complete with first fill of oil along with fittings and accessories. ***Accessories Fitted with Transformers*** *Marshalling box, HV/LV Bushings, Bottom Drain cum Filter valve, Top / Bottom oil sampling valve, Tap changing switch, PRV, etc.* ***Loose items :***	*4 sets**

	HV/LV cable box with disconnecting chamber, Conservator tank with Prismatic oil level gauge, Double float Buchholz relay valves, Silica gel breather with pipe, P.S. Radiator, Explosion vent, Remote WTI , etc. ***Approximate dimensions*** *Overall dimensions : 4025(L)X3400(B)X3250(H) mm* *Shipping Dimension of Largest package:3800(L)X2100(B)X2200(H) mm* ***Weight of each Transformer Components*** *Core and Coil - 5600 Kg approx.* *Oil - 2400 Kg approx.* *Oil Quantity - 2695 Ltrs approx.* *Total weight - 12100 Kg approx.* *Weight of heaviest package- 10285 Kg approx.* ** Lump sum rate to be quoted*	
D.3.0	***VFD PANELS***	
D.3.1	***VFD Switchgear Panel*** *11 KV, indoor, metal clad, vacuum break switchgear panel with 1250A incomer & Bus PT along with associated loose supplied items.* *VFD Switch gear consists of 2 Panels in suitable shipping sections.* *Overall dimension: 1640 mm (L) x 2355 mm (D) x 2300 mm(H)* *Weight of Shipping section for 2 Panel: 2000Kg approx* ** Lump sum rate to be quoted.*	*4 sets**
D.3.2	***LCI Drive Panel:*** *Comprising Control and Excitation Panel, Fan and Filter Panels with air duct for exhausting air and Bridge Panel.* *Size: 6400(L) x 1550(D) x 2650(H) mm; Weight: 4500 Kg approx.* ** Lump sum rate to be quoted.*	*4 sets**
D.3.3	***Adaptor Cubicle*** *Size: 750 x 1550 x 2650 mm; weight: 400 Kg approx.*	*4 sets*
D.3.4	***Common Control Panel for VFD Drives*** *Size: 1050x 1550 x 2650 mm; weight: 600 Kg approx.* ***including PC System for MMI*** ** Lump sum rate to be quoted.*	*2 sets**
D.3.5	***Air core DC link Reactor*** *Floor/channel mounting type, 30 mH, 800 A rated air cored DC reactor housed in 3-5mm thick Aluminium cubicle with suitable input/output terminals* *Dimension: 2700(L) x 2450(B) x 2325(H) mm, Weight: 2600 Kg approx.*	*4 sets.*

D.4.0	***LAYING AND TERMINATION OF OF LT /CONTROL CABLES*** *1.1 KV Grade, Cu/Al conductors, PVC insulated, PVC inner sheath, un armoured with overall FRLS,PVC outer sheath cable,*	
D.4.1	*2C X 2.5 Sq.mm*	*1150Mtrs*
D.4.2	*2C X 1.5 Sq.mm*	*3300Mtrs*
D.4.3	*4C X 1.5 Sq.mm*	*150 Mtrs*
D.4.4	*14C X 1.5 Sq.mm*	*200 Mtrs*
D.5.0	***Instrumentation cables***	
	Laying and Termination of Individual Pair & Overall Shielded, Twisted Pair, Armoured cables	
D.5.1	*2 Pair x 0.5 mm2*	*800Mtrs*
D.5.2	*4 Pair x 0.5 mm2*	*3300Mtrs*
D.5.3	*12 Pair x 0.5 mm2*	*1100Mtrs*
D.6.0	***Laying and Termination of Overall Shielded, Twisted Pair, Armoured cables***	
D.6.1	*2 Pair x 0.5 mm2*	*1680Mtrs*
D.6.2	*4 Pair x 0.5 mm2*	*2380Mtrs*
D.6.3	*8 Pair x 0.5 mm2*	*2440Mtrs*
D.6.4	*14 Pair x 0.5 mm2*	*800Mtrs*
E.0	***COMMISSIONING OF THE FOLLOWING ERECTED BY MECHANICAL CONTRACTOR***	
E.1.0	***600 MW Generator*** *H.V. testing, meggering of Bushings & Accessories, resistance measurement, meggering including dry out of generator.*	*1 No.$*
E.2.0	***HT Motors***	
E.2.1	*11 KV Motors*	*5 Nos.*
E.2.2	*3.3 KV Motors*	*21Nos.*
E.3.0	***ESP Transformer*** *Commissioning of High voltage rectifier transformer –95 KVp, 800 mA Mineral oil HVR, Single Phase, 50 Hz, Silicon Diode Bridge Rectifier, approx. Oil capacity of 625 Ltrs.* *The scope of work includes oil filtration, sample testing for dielectric strength, PPM etc., calibration of WTI, Buchholz relay etc.*	*64 nos. $*
F.	***BHEL-EDN SCOPE***	
F.1.0	*Unit Control Panel* *Size 1050(L) x 1050 (D) x 2700(H) mm; Approx. weight-600kg*	*1set*
F.2.0	Electrical Control Panel Size 1050 (L) x 1050(D) x 2700(H) mm; Approx. weight-600kg	*1set*
G.	***BHEL - TRICHY SCOPE***	
G.1.0	***Soot Blower MCC*** *Size: 18000(L) x 1000 x 2400mm; Wt : 11400 kg approx.*	*1 No.*
G.2.0	*FTP Local starter panels*	*2 Nos.*

	Size: 650 x 300 x 1000 mm; Wt: 25 kg each	
G.3.0	*D.C. Starter panel for Scanner air fan* *Size: 900 x 375 x 1120, Wt :50 kg*	*1 No.*
G.4.0	*Junction Box for APH SB Local start/stop push button*	*2 Nos.*
G.5.0	***Hot Dipped Galvanised Cable Trays,** complete with coupler plates, fasteners etc.*	
G.5.1	*Perforated tray 100 mm wide*	*1500 Mtrs*
G.6.0	***LAYING & TERMINATION OF LT POWER / CONTROL CABLES: XLPE / PVC insulated, armoured Copper / Aluminium cable.***	
G.6.1	*3 C X 2.5 sq. mm*	*75000 Mtrs*
G.6.2	*7 C x 1.5 Sq. mm*	18000 Mtrs
G.6.3	*10 C x 1.5 Sq. mm*	24000 Mtrs
G 6.4	*2 P x 0.5 sq.mm O/A shielded cable*	750 Mtrs
G 6.5	*4 P x 0.5 sq.mm O/A shielded cable*	2000 Mtrs
G 6.6	*8 P x 0.5 sq.mm O/A shielded cable*	4500 Mtrs
G 6.7	*8 P x 0.5 sq.mm Indiv. & Coll. shielded cable*	500 Mtrs
G.7.0	***STRUCTURAL STEEL***	
G.7.1	*CHANNEL , ISMC 100 X50*	*2 MT*
G.7.2	*ANGLE, ISA, 50 X 50X 6*	*3MT*
G.8.0	***ELECTRICAL COMMISSIONING** of the following erected by Mechanical Contractor*	
G.8.1	*Soot Blowers (LRSB / WB/AH etc) including commissioning of 2 Nos. motors, setting of limit switches etc.*	*258 Nos. $*
	$ Rate to be quoted for commissioning only	
H.	***BHEL – RANIPET SCOPE***	
H.1.0	***ESP CONTROL PANELS / MCC***	
H.1.1	*Auxiliary Control Panel* *Overall dimension:5900 (L) x 1300(W) x 2450(H) mm (approx.)* *Approximate Weight : 5600 kg for each Panel*	*4 Nos.*
H.1.2	*LT Main switch board (LTMSB)* *Overall dimensions-8850(L) x 1700(W) x 2450(H) mm (approx.)* *Approximate Weight - 10000kg for each board*	*4 Nos.*
H.1.3	*Electronic Control Panel with Bapcon controller (01 no. per ECP) shall be supplied loose for mounting in the panel.* *Size : 600 x 550 x 2000 mm(approx.)* *Approximate Weight : 300 kg*	*64Nos.*
H.1.4	*IOS panel with stand alone PC with colour monitor, Data logger PC with colour monitor, printers and other accessories etc.* *Size : 1000 x 650 x 2050 mm; 200 kg (approx.)*	*1 Set*

H.1.5	*Rapper Control Panel with Rapcon controllers (02 nos per RCP) shall be supplied loose for mounting in the panel.* *Size : 1000 x650 x 2050 mm(approx.)* *Approximate Weight : 300 kg*	*4 Nos.*
H.1.6	*Ash level indicator with probe(High & Low)* *Weight of ALI: Approx 2.6 kg per ALI*	*256 Nos.*
H.1.7	*Laying and dressing of GI Flexible Metallic Conduit with fixing hardwares, laying of PTFE shielded signal cable and 1.0 sqmm PVC insulated copper wire for Ash level indicating system (Quantity indicated is for each item)*	*3840 Mtrs*
H.2.0	***JUNCTION BOXES / LOCAL START STOP PUSH BUTTONS***	
H.2.1	*Local Start Stop Push Buttons (for Rapping Motors)* *Approx.Size: 180 x 100 x 250 mm; approximate wt 2.5 kg each*	*136 Nos.*
H.2.2	*Junction Boxes for hopper Heaters* *Approx.Size: 400 x 150 x 315 mm; approximate wt 10 kg per JB*	*64 Nos.*
H.2.3	*Junction Boxes for support insulator heaters, shaft insulator heaters* *Approx.Size: 400 x 150 x 315 mm; approximate wt 15 kg each*	*8 Nos.*
H.2.4	*Junction Boxes for start stop PB , hopper thermostat, ALI* *Approx.Size: 600x 150 x31 mm; approximate wt 12 kg each*	*38 Nos.*
H.3.0	***CABLE TRAYS(LADDER TYPE)*** *complete with ,coupler plates,fasteners etc.,*	
H.3.1	*Ladder type 600 mm wide*	*1800 Mtrs*
H.3.2	*Ladder type 450 mm wide*	*2300 Mtrs*
H.3.3	*Ladder type 300 mm wide*	*800Mtrs*
H.3.4	*Ladder type 150 mm wide*	*5000mtrs*
H.4.0	***LAYING OF LT POWER/ CONTROL CABLES***	
	1.1 KV Grade, PVC insulated, Unarmoured / Armoured, Aluminium / Copper cable.	
H.4.1	*3.5Cx300 sq.mm, Aluminium, Armoured*	*1200 Mtrs*
H.4.2	*3 C X 50 sq. mm, Aluminium, Armoured*	*3000 Mtrs*
H.4.3	*3 C X 16 sq. mm, Aluminium, Armoured*	*900 Mtrs*
H.4.4	*2 C X 120 sq. mm, Aluminium, Armoured*	*37600 Mtrs*
H.4.5	*3C X 10 sq. mm, Aluminium, Armoured*	*13000 Mtrs*
H 5.0	***TERMINATION OF LT POWER CABLES***	
H 5.1	*3.5 Cx300 sq.mm, Aluminium, Armoured*	*32 Nos*
H 5.2	*3 C X 50 sq. mm, Aluminium, Armoured*	*32 Nos*
H 5.3	*3 C X 16 sq. mm, Aluminium, Armoured*	*168 Nos.*
H 5.4	*2 C X 120 sq. mm, Aluminium, Armoured*	*576 Nos*
H 5.5	*3 C X 10 sq. mm, Aluminium, Armoured*	*64 Nos.*
H 6.0	***LAYING AND TERMINATION OF LT POWER/ CONTROL CABLES***	
	1.1 KV Grade, PVC insulated, Unarmoured / Armoured, Aluminium / Copper cable.	

H 6.1	*3C X 2.5 sq. mm, Copper, Armoured*	*43000 Mtrs*
H 6.2	*2 C X 2.5 sq. mm, Copper, unarmoured*	*14,000 Mtrs*
H 6.3	*7Cx 2.5 sq.mm Copper, armoured*	*10000 Mtrs*
H 6.4	*10Cx2.5 sq.mm Copper, unarmoured*	*28000 Mtrs*
H 6.5	*4 C X 1.5 sq. mm, LT Screened copper armoured cable,*	*21000 Mtrs*
H.7.0	***EARTHING MATERIALS***	
H.7.1	*GI Flat 50 x 6 mm*	*3300 Mtrs*
H.7.2	*GI Flat 30 x 5 mm*	*2700 Mtrs*
H.7.3	*GI wire -3.15*	*17000Mtrs*
H.8.0	***STRUCTURAL STEEL***	
H.8.1	*ISA 50 X 50 X 6*	*15300 kg*
H.8.2	*ISMC 75*	*11500 kg*
H.8.3	*ISMC 200*	*3360 kg*
H.9.0	***ELECTRICAL COMMISSIONING*** *of the following erected by Mechanical Contractor*	
H.9.1	*LT Drives of ESP*	*152 Nos $*
H.9.2	*Hoists/cranes/monorail*	*17 Nos $*
H.9.3	*Testing, Termination and dressing of Heating Elements for Hopper*	*1536 Nos $*
H.9.4	*Testing Heating elements for support insulator heater*	*256 Nos$*
H.9.5	*Testing Heating elements for shaft insulator heater*	*64 Nos $*
H.9.6	*Testing Thermostats for hopper heaters.*	*64 Nos $*
H.9.7	*Testing Thermostat for support insulators*	*8 Nos $*
	$ Rate to be quoted for commissioning only	
I.	***BHEL-HYDERABAD SCOPE***	
I.1.0	***TD BFP PANELS***	
I.1.1	*D.C. Starter Panels with Resistance Box For EOPs* *Approximate size : 800 x 800 x 2280 mm; Wt: 800 kg each*	*2 Nos.*
I.1.2	*Lube Oil Purification Equipment Panel* *Approximate size:1000x800x2280 mm:Wt: 800 Kg Approx*	*1 No.$*
	$ Rate to be quoted for commissioning only	
J.	***BHEL-HARIDWAR SCOPE***	
J.1.0	*D.C. Starter Cabinet with Resistance box for DC Seal Oil Motor (Clause 1.7.1.5)* *Approximate size:1000 x 800 x 2200 mm; Wt :450 kg*	*1 No.*
J 2.0	*D.C. Starter Panels with Resistance Box For JOP* *Approximate size:1000 x 800 x 2200 mm; Wt :450 kg*	*1 No*

J.3.0	*D.C. Starter Panels with Resistance Box For EOP* *Approximate size & Wt.: 1000 x 800 x 2200 mm; 450 kg*	*1 No.*
	$ Rate to be quoted for commissioning only	
K.1.0	***ELECTRICAL COMMISSIONING of the following erected by Mechanical Contractor***	
K.1.1	*LT Motors ,Electrical actuators for valves & dampers*	500Nos. $
K.1.2	*Exciter dryer / heater*	*03 No.* $
K.1.3	*Generator Air Drier*	*01 No.* $
K.1.4	*CO_2 Vaporizer*	*01 No.* $
K.1.5	*Exciter Stroboscope*	*01 Set.* $
K.1.6	*Control Panel for Hydrogen Dosing System (skid mounted)*	*01 No.* $
K.1.7	*Control Panel for Ammonia Dosing System (skid mounted)*	*01 No.* $
K.1.8	*Control Panel for NAOH Dosing System (skid mounted)*	*01 No.* $
K.1.9	*Control Panel for Phosphate Dosing System (skid mounted)* *Supply by BHEL/PC*	*01 No.* $
	$ Rate to be quoted for commissioning only	

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 (including extended 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.

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 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 inspectorate 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.

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.

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 site 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 drawls 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, insulation etc., to commence their work from / on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by

BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the 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.

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 separate Erection In-charges, each for HT and LT electrical work. 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

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 -1 of this booklet contains general guidelines for Erection and Commissioning of Electrical package

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.

1.11.7 The certificates of the grout is to be submitted to 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.

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 site of work at his 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 damps, sinking into around 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 decolonization takes place or regenerated. BHEL shall supply the material and contractor shall replace.

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 categorized and stored separately.

VOLUME-IA PART –I CHAPTER -X III
SCOPE OF WORK-DETAILED

SCOPE OF WORKS- HT ELECTRICAL -DETAILED

1.13.1 TRANSFORMERS

1.13.1.1 Different types of transformers like oil immersed or dry type shall be supplied as indicated below.

1.13.1.1.1 GENERATOR TRANSFORMER - 240 MVA

Description: *The generator transformer shall be of 240 MVA, (420/√3)/21 kV, single phase transformer , OFAF/ONAN/ONAF Cooled, YNd11 , with accessories like radiator banks, off load tap changer, HV/LV/LVN bushings, Bushing CTs, Turrets, Conservatiors, Cooler control cabinet, marshalling box, pipings etc.. Loose items like facia windows, W.T.I repeaters,buzzres, signal lamps, etc. shall be mounted and wired in control panel.*

Refer BOQ and reference drawings for more details

1.13.1.1.2 STATION TRANSFORMER

Description: *Unit and station transformer shall be of 80 MVA, 400/11.5 KV, 3 phase, ONAN/ONAF, Dyn1 with On Load Tap Changer +7.5 % to -12.5 % in steps of 1.25% on HV side, with accessories like CTs, radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc. Loose items like raise /lower P.Bs, tap changer indicators, facia windows, W.T.I repeaters, buzzers, signal lamps, NGR etc. shall be mounted and wired in control panel.*

Refer BOQ and reference drawings for more details

1.13.1.1.2 UNIT TRANSFORMER

Description: *Unit and station transformer shall be of 31.5 MVA, 21/11.5 KV, 3 phase, ONAN/ONAF, Dyn1 with On Load Tap Changer +10% to -10% in steps of 1.25% on HV side, with accessories like CTs, radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc. Loose items like raise /lower P.Bs, tap changer indicators, facia windows, W.T.I repeaters, buzzers, signal lamps, NGR etc. shall be mounted and wired in control panel.*

Refer BOQ and reference drawings for more details

1.13.1.1.3 UNIT& STATION AUX. TRANSFORMER.

Description: *Unit Aux.transformer shall be of 16 MVA, 11/3.6 kV, 3 phase, ONAN, Dyn1 Unit Aux. Transformer with Off Load Tap Changer +10 % to -10% in steps of 2.5% ON HV side, with accessories like CTs, radiators, cooling fans, conservator, cooler control panel, marshalling panels, piping etc. Loose items like tap changer indicators, facia windows, W.T.I repeaters, buzzers, signal lamps, NGR etc. shall be mounted and wired in control panel.*

Refer BOQ more details

1.13.1.1.6 ***VFD TRANSFORMERS***

Description*: VFD transformer shall be of 4600 KVA, 11/4.1KV, 3 Phase, ONAN, Outdoor type transformer complete with first fill of oil along with conservator tank with prismatic oil level, Double float Buchholz relay with 02 nos. valves, Silica gel breather with pipe, P.S. Radiator-08 nos., HV/LV cable box with disconnecting chamber, Marshalling box, PRV, Remote winding temperature indicator, etc.*

Refer BOQ for more details

1.13.1.1.7 ESP High voltage rectifier transformers

High voltage rectifier transformer (95 KV, 800ma) will be erected by Mechanical contractor. Testing and commissioning of ESP transformer in Electrical contractor's scope.

The scope of work for ESP transformer is detailed under clause 1.15.1

1.13.1.1.8 ***N.G.R (11KV) (Unit & Station transformer)***

11 KV, 400A, 16.6 Ohms, outdoor type NGR with support structure, Copper strip, HT porcelain support insulator, Foundation bolts, etc.

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

1.13.1.1.9 N.G.R (3.6KV) (unit Aux. Transformer)

3.3 KV, 400A, 9.96 Ohms, outdoor type NGR with supporting structure, Copper strip, HT porcelain support insulator, Foundation bolts, etc.

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

1.13.1.2 SCOPE OF WORK OF TRANSFORMER

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

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

1.13.1.2.2 Transformers shall be transported from storage yard in a suitable trailer, unload at their respective locations and install as per the installation drawing. The contractor will unload the transformers on rails, turn the wheels / rollers if necessary for changing over at right angles on rails, roll the transformers to their respective locations and put them on the foundation. The necessary sleepers, winches, jacks etc. required for this operation will be arranged by the

contractor at his cost. The other transformers will be shifted with suitable material handling equipment to the respective location.

1.13.1.2.3 Generator, UT and UAT and other transformers will be sent to site in several packages which will have to be erected / assembled at site. Contractor shall arrange to assemble at site and carry out testing as mentioned above

1.13.1.2.4 Samples of each and every drum of Transformer oil have to be tested and pre-treated to achieve the desired value before filling in to the transformer tank. The entire arrangement for testing the oil sample, filtering whenever required to achieve the desired PPM, BDV within the shortest time shall be made by the contractor. Oil tests as per IS 335 including dissolved gases analysis has to be conducted by contractor for transformers of rating above 200 KV. The job has to be taken up in consultation with BHEL Engineers at site at the cost of the contractor. All the test equipment for testing PPM, BDV of the oil including testing equipment required for the Tan-Delta Test of the transformer winding and HV Bushing shall be arranged by the contractor. HV Bushings shall be tested for capacitance and tan delta test before erection also. Testing instruments required for DEW measurement of N2 gas shall also be arranged by the contractor

1.13.1.2.5 All the T&P, material handling equipment like cranes, Trailer, 1 (one) number of High Vacuum filter machines with adequate capacity (5 to 6 KL/hr), vacuum pumps and 5 kV motorized megger and oil tank of suitable capacity shall be arranged by the contractor at his cost. Contractor shall arrange one no 1 to 1.5 kl/hr filtration machine for filtration of smaller transformers. The transformers may have to be suitably lagged / covered during the drying out operation by the contractor at no extra cost.

1.13.1.2.6 The contractor will engage his men on three-shift operation during drying out the transformers.

1.13.1.2.7 Auxiliary / Service transformers will be bolted to the adopter panel / bus duct on both the sides and the busbars will be connected together. The contractor at no extra cost shall carry out any modification required in the bus connectors for matching the PCC Bus bar with the transformers LT side.

1.13.1.2.8 The auxiliaries components of the above transformers are to be cleaned and checked before the assembly as instructed by BHEL Engineer.

1.13.1.2.9 The contractor shall carry out testing and commissioning works by their own testing equipments and Testing Engineers under the supervision of BHEL Engineer.

1.13.1.2.10 Filtration and dry out shall be carried out to obtain value of dielectric strength / PPM, resistivity, specific gravity, dissolved gas analysis, and Tan-Delta test shall be as per recommended value of BHEL. The final tests have to be carried out at approved laboratories like CPRI etc. and test certificates are to be submitted to BHEL. If the test results are not satisfactory and if the

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

1.13.1.2.11 All the transformers protective system such as Buchholz relay explosion vent, oil and winding temperature detectors etc., healthiness are to be checked under the guidance of BHEL Engineer. All HV bushings will have to be tested for capacitance and tan delta value. All transformers of 220 KV and above shall be tested for capacitance and tan delta value after commissioning.

1.13.1.2.12 Transformer protective relays are to be checked prior to the commissioning of the transformer.

1.13.1.2.13 The scope of erection work includes final painting, minor civil work such as chipping an grouting of the support structure foundations as well as for the support foundation of the transformer. Final painting shall be carried out for all the Transformers excepting Dry type Indoor Transformers. The scope of final painting involves supply of paints, thinner and other consumables at the cost of the contractor as detailed in VOLUME-IA PART- I CHAPTER-XVI (Painting). No separate rate shall be paid for painting.

1.13.1.2.14 During the oil circulation of the transformer, the contractor has to employ sufficient number of

personnel who will take care of the operation of the filter machine as well as safety of the transformer.

1.13.1.2.15 The contractor shall prepare all log sheets, test certificates, protocols etc. as per field quality plan, get it signed by concerned BHEL / Customer Engineer and submit to the concerned BHEL Engineer

1.13.1.2.16 Preservative gas like N_2 shall be supplied by BHEL free of cost to maintain the N_2 pressure during preservation

1.13.1.2.17 *The contractor shall maintain the equipment erected and commissioned by him until taken over by Customer*.

1.13.1.2.18 BHEL will provide 75 Ton capacity cranes for the purpose of erection of transformer assembly on sharing basis at free of hire charges. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.

1.13.1.2.19 *The contractor shall arrange one 5 to 6 kl/hr, and one 1 to 1.5kl/hr filtering machine additionally to the meet erection / commissioning schedule. All the free issue equipments shall be returned to BHEL in good condition and any defects noticed at the time of handing over shall be rectified by the contractor*.

1.13.1.2.20 Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor. Name of the equipment erected by the contractor shall be painted boldly as per the agreed colour scheme on the equipment.

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

1.13.2.1 ***GENERAL CONSTRUCTION AND OPERATION OF HT SWITCHGEAR:***

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

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

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

1.13.2.2 ***DETAILED SPECIFICATION OF SWITCHGEAR***

11KV SWITCHGEAR

Details of equipment:

System Nominal : 11 KV, 3 PHASE, 50 Hz

System Voltage Highest : 12 KV

6.6 KV SWITCHGEAR

Details of equipment:

System Nominal : 3.3 KV, 3 PHASE, 50 Hz

System Voltage Highest : 3.6 KV

The details of switch boards are given in BOQ.

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

i. The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.

ii. The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. Base channels shall be grouted on the opening of the floor. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If base frame is to be fabricated /

erected, separate rate shall be paid on Tonnage basis. Contractor to arrange anchor bolts required if any.

iii. *For the panels to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted.*

iv. *The contractor shall carry out fabrication and erection of these support structures and separate rate shall be paid on Tonnage basis.*

v. *The contractor shall set each section of equipment on its foundation or supporting structures. The contractor shall assemble equipment as required. Skilled craftsmen arranged by the contractor shall install all equipment with parallel, horizontal and vertical alignment.*

vi. *Panels will be delivered in different shipping sections. Necessary interconnection of busbar, inter panel wiring, etc. shall be carried out as part of panel erection.*

vii. *Normally the panels shall be supplied with complete Relays / Instruments and other Components mounted and wired. However, any minor modifications like dismantling of the existing Relays / Instruments / Components and mounting of new Relays / instruments / components and rewiring to suit operating conditions, will be carried out without any extra cost. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra works basis. Similarly if any Relays/ Instruments /component supplied as loose for safety transit, same shall be mounted and wired as per site requirement at free of cost as part of scope of the job. However, if the loose supplied Relays / Instruments / Components are more than 10% of the total quantity, the same shall be carried out at extra works basis. Decision of site engineer shall be final regarding such extra works.*

viii. *The commissioning of HT Switchgear shall also involve the trial runs and commissioning of all connected equipment like motors and Service Transformer. The contractor will have to keep his people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc. required in the equipment erected by him. (Separate rate shall be paid for commissioning of associated electrical drives as per BOM). Contractor has to co-ordinate with C&I contractors to make the interconnecting cables through.*

ix. *The contractor has to do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.*

x. *All T&P, Material handling equipment including cranes and Relay Testing / HV Testing / Calibration equipment / Instruments shall be arranged by contractor. Three phase current injection kit required for calibration of relays shall be arranged by the contractor. The contractor shall carry out testing and commissioning works using their own testing equipments and Testing Engineers under the supervision of BHEL Engineer. EOT crane shall be given free of cost for shifting the panels from and to electrical room. In addition refer clauses of VOLUME-IA PART – I CHAPTER –*

xi. *Switch boards incomer bus shall be connected to SP bus ducts, through adapter box. The contractor shall co-ordinate for proper bus bar connection. Any modification*

required in the bus conductor for matching SP bus duct and bus bar, the same shall be carried out without extra cost.

xii. *Contractor shall co-ordinate with cable jointer and other LT cable laying agency for proper cable termination and also during HP testing of cable.*

xiii. *The contractor shall prepare all erection/ commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL / Customer Engineer and submit the same to BHEL Engineer as per his instruction.*

xiv. *The charged and commissioned equipment shall be maintained by the contractor till the same is taken over by Customer*

xv. *Any items like lamps, lens, fuse / relays / instruments missed form the custody if the contractor shall be replaced by the contractor at free of cost.*

xvi. *Rubber mats for HT switchgear shall be supplied by BHEL, and these shall be laid, wherever required, by the contractor at free of cost.*

xvii. *The contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer at free of cost*

xviii. *If any removal/ Re-fixing of contactors/relays becomes necessary for the completion of the system, the same shall be done by the contractor at free of cost.*

xix. *Scope of work shall also cover drilling of bottom gland plates for cable entry as required.*

xx. *The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc.*

xxi. *Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments, transducers mounted on the panels.*

xxii. *If panels are supplied with monitor, printers, furniture, controller etc. or any loose items or equipments, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items unless specifically given in the BOQ.*

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

xxiv. *The contractor shall arrange watch and ward for the equipment under his custody and erected in location against theft and damage by other agencies working on the same area. Contractor shall arrange to paint/stick good quality danger boards where ever required. Required boards shall be arranged by contractor.*

Note:-

1. *Dimensions & weights indicated in the BOM against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within ±20% shall not be considered for payment. However, for variations beyond ±20%, payment shall be considered proportional to the length*

of the panel. Variations in depth, height or weight of the panel shall not be considered for payment.

2. *Subject to availability, BHEL will provide EOT cranes for the purpose of shifting the panels within the PH building on sharing basis at free of cost. However, the contractor shall arrange operator and other T&P. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.*

1.13.3 BUSDUCTS

1.13.3.1 BHEL SCOPE OF SUPPLY

Two types of bus ducts will be supplied by BHEL for this project as detailed below.

a) *HT Isolated Phase Busducts from Generator to Generator Transformer(main & Delta)*

b) *HT Isolated phase bus ducts -Tap off from main to Unit/Station transformers*

b) *HT Segregated Phase Busduct between Unit Transformers / Unit Aux Transformers and 11 kV Switchboards and 3.3 kV Switchboards and associated interconnection / Tie Bus ducts.*

1.13.3.2 ISOLATED PHASE BUSDUCTS

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

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

A totally enclosed neutral grounding cubicle is provided to connect the Generator neutral point. The neutral grounding cubicle houses neutral grounding transformer & resistors.

Air pressurization equipment unit and Hot air blowing equipment will be supplied with the generator isolated bus ducts.

BHEL will supply one set of shorting bars common for both the units for generator dryout

The tentative details are as under.

1. *Rated Voltage : 22 kV*
2. *Highest system voltage : 24 KV.*
3. *Type of Bus bar joints : Bolted /Aluminum welded*

SP & VT Cubicle , LAVT cubicle

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

NG Cubicle

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

i. Dry type epoxy cast NG transformer 1 No.

ii. NG Resistor

Busduct Supporting Structure

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

1.13.3.3 SEGREGATED PHASE BUSDUCTS(SP Bus ducts)

General Description

Segregated phase busduct shall be supplied complete with AL alloy enclosure and conductor, AL alloy barrier, single epoxy porcelain bus support insulator arrangement, rubber bellows, inspection windows etc. All bolted joints shall have high tensile steel hardware which shall be cadmium plated / zinc plated and passivated. All conductor bolted joints shall be silver plated. SP HT Busducts shall be connected to Unit Transformer, Unit Auxiliary Transformer and 11/6.6 KV Switchgear.

The tentative details of bus duct are as given below:

Insulation level: 35 KV for 11 KV & 27 KV for 3.3 KV

1.13.3.4 BUSDUCT SUPPORTING STRUCTURE:

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

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

1.13.3.5 SCOPE OF WORKS FOR ERECTION & COMMISSIONING OF BUSDUCTS

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

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

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

There may be variations in the weight and dimensions. Any variation in the length of Busducts within ±20% shall not be considered for payment. However, for variations beyond ±20%, payment shall be considered proportional to the length of the Busducts. Variations in width or height or weight including support structure shall not be considered for payment.

Detailed scope of work shall as below:

a. *Transport of Busducts and associated items and equipment from BHEL Stores to erection site. Cleaning of enclosure and conductors, insulators and other panels before assembly and erection.*
b. *Placement of embedment and erection and alignment of steel support structures.*
c. *Assembly and checking of bus duct at ground level if necessary.*
d. *Fixing of wall bushings / wall frame assembly*
e. *Providing earthing connections as per site conditions.*
f. *Minor civil work such as chipping and drilling holes on concrete if necessary and grouting of busduct support structures including supply of materials required for civil works.*
g. *Carrying out required level of cleaning inside as well as outside of the busduct for the purpose of conducting high voltage test before commissioning of the unit.*
h. *Earthing as detailed in the relevant bus duct drawings.*
i. *Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures)*
j. *Extension of embedment if required and erection of required supports structures as detailed in the drawing.*
k. *Tightening of all bolts in the joints and flanges by calibrated torque wrench to the approved pressure (Anti oxidation compound will be used for joints which will be arranged by contractor)*

l. *Conducting air-tightness test after erection to meet the requirement of BHEL / Customer Standards.*

m. *Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, rotameter etc. at their cost. Contractors shall tap the air from nearest Instruments air tapping point available at site.*

n. *Conducting high voltage test for IP/SP bus ducts, short circuit test for IP bus ducts and other tests as detailed in Section VII as per instruction of BHEL engineer after making necessary cleaning inside as well as outside of the bus duct & arranging all testing equipment required for carrying out bus duct testing. Each bus duct pieces will have to be tested for IR value and HV test at working voltage before erection.*

o. *Fixing of Current transformers in bus ducts including wiring from CT terminal to junction box, taking through rigid/flexible conduit pipe.*

p. *Fixing of Space Heaters on the busducts including wiring from Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe*

q. *Fixing of Breather wherever required.*

r. *Carrying out millivolt drop test is in contractors scope*

s. *Testing of all CTs, VTs as per BHEL's Field quality Plan*

t. *Erection of GI conduit for space heaters, erection of JBs, wiring for space heaters, testing and commissioning shall be done.*

u. *Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer VOLUME-IA PART – I CHAPTER – XVI (Painting). Name of the equipment shall be painted boldly as per the instruction of site engineer. Any danger boards required to be displayed shall be arranged by the contractor.*

v. *BHEL will provide 75 Ton capacity cranes for the purpose of erection on sharing basis at free of cost. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.*

1.13.3.6 SCOPE OF WORK SPECIFIC FOR ISOLATED PHASE BUS DUCTS:

1. *Erection and commissioning of NG cubicle with all its accessories if supplied as loose.*
2. *Fixing of neutral side flexible connections to generator and position of neutral CTs after testing.*
3. *Assembly, erection, testing and commissioning of VT, SP & VT, NGT, NGR cubicles with its equipment such as lightning arrestors, voltage transformers, fuses, etc.*
4. *Erection and alignment of TEE OFF busducts for unit transformer, SP & VT cubicle etc.*
5. *Grouting of bus duct support structures.*
6. *Erection and commissioning of air pressurization equipment with all the*

accessories.

7. *Carrying out aluminum welding for bus conductor and on enclosure as detailed in the drawing using MIG / TIG machine with the Aluminum filler wire as per BHEL specification.*
8. *Providing of MIG / TIG welding machine, aluminum filler wire, Argon gas of high purity and other required consumables as per BHEL standard for efficient aluminum welding, covering supporting insulators with asbestos cloth whenever aluminum welding is carried out near the supporting insulator.*
9. *Making necessary modifications of makeup pieces, if required, and welding of isolated phase bus ducts along with NGT, SP & VT cubicle, UT tap-offs and delta connections.*
10. *Conducting 10 % X - ray and 100 % DPT test on all welded joints of conductor and enclosure and arranging the required radiographic and NDT equipment.*
11. *Providing well-experienced Aluminium welder to meet the required quality.*
12. *Grouting the ground bus provided on the entire length of entire length of busducts, all parts of supporting structures and one end of each enclosure.*
13. *Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.*
14. *Arranging all T&P material handling equipment required for erection.*
15. *Calibration of all inspection, measuring and test equipment (IMTEs) before using.*
16. *Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.*
17. *Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan and getting them signed by BHEL / Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.*
18. *Maintaining the equipment after commissioning till taken over by Customer*
19. *Other requirement for Erection / Commissioning of IP Busducts.*
    - a- *Aluminium welders shall appear for test as directed by the BHEL welding Engineer and only test qualified welders shall be permitted to do the welding.*
    - b- *For MIG / TIG welding only high purity argon gas shall be used. If the contractor is unable to arrange the required high purity Argon gas, the same shall be arranged by BHEL on chargeable basis. The cost of gas shall be recovered from the running bills as per BHEL norms.*
    - c- *Aluminium filler wire / rod shall be procured in consultation with BHEL Welding Engineer from approved Vendors of BHEL.*
    - d- *Make up pieces shall be supplied along with bus ducts. Necessary MIG / TIG welding of different sections of enclosures, make up pieces and bus will be carried out at site.*

e- Holes on the flanges may not be adequate or may not match and any additional holes required same shall be drilled at site to facilitate matching of busduct enclosure flanges including generator flange.

f- BHEL will provide EOT crane at free of cost. In addition refer clauses of VOLUME-IA PART – I CHAPTER – V.

g- Connecting the Bus duct with other equipment erected by other agencies is in the scope of Bus duct erection.

h- Any minor modification required in the bus conductor / enclosure of the bus duct for matching the switch gear in-comer and transformer adopted box shall be carried out without additional cost.

1.13.4 GENERATOR CIRCUIT BREAKER

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

Rated voltage - 24 KV

Rated continuous current - 21 kA

Total weight of circuit breaker - 7470 kg approx

Dimensions: 6719 mm x 3746 mm x 3457 mm

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

1.13.5 SCOPE OF WORK FOR CABLES:

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

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

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

1.13.5.4 Cable Termination

- *Termination of HT cable shall be treated as part of installation of HT termination kits and no separate rate shall be applicable for the same.*

- *Separate rate shall be paid for termination of LT Power cables of Higher sizes. Such cables will be indicated in the BOM/ Rate Schedule.*
- *For all other cables, a composite rate covering laying and termination shall be applicable.*

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

1.13.5.6 Unit rate quoted for cable shall cover laying, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required fixing of cable glands, fixing of glands, ferrules termination, and providing tag plates and dressing.

1.13.5.7 Unit rates quoted for cabling shall also include supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed in General GuideLines.

1.13.5.8 Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.

1.13.5.9 The Ethernet cables shall be isolated from other cables and laid in a separate cable tray or conduit as directed by site Engineer.

1.13.5.10 The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. For LT cable joining, if any, separate rate shall be considered on extra works basis.

1.13.5.11 *The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.*

1.13.5.12 Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.

1.13.5.13 During testing and commissioning, if the equipment on which the cables are terminated not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling, The contractor shall promptly depute his supervisor or technicians to assist the commissioning agencies to check the interconnecting cables.

1.13.5.14 *Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.*

1.13.5.15 The approximate number of termination for the purpose of estimation to be assumed as follows: The average run length shall be considered as 150 Mtrs.

1.13.5.16 SCOPE OF CABLE TERMINATION

i) The scope of termination shall include termination of cables on various equipment installed by others.

ii) *Re-termination if required during testing / commissioning, shall be carried out without additional cost.*

iii) *Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation.*

iv) *Contractor shall arrange all type of termination and crimping Tools/ equipments required for the connections/terminations.*

v) ***Only printed ferrules should be used and contractor shall arrange necessary ferrules printer.***

vi) *After cable terminations, the debris shall be removed then & there*

1.13.6 ***SCOPE OF CALIBRATION:***

a. *The contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, recorders, Indicators etc. that will be supplied along with equipments mounted in or in loose.*

b. *Contractor shall maintain calibration records as per the BHEL prescribed format.*

c. *All testing Instruments/Equipment deployed for calibration shall be calibrated before taking into service. A copy of calibration certificate shall be submitted to the engineer for his verification and approval.*

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

e. *BHEL shall provide vendor supports for proprietary type of microprocessor – based instruments, protective relays, which requires software loading and programming etc. 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 instruments.*

f. *If BHEL is unable to 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 the 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 with in quoted rate.*

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

1.13.7 ***SCOPE OF WORK FOR FABRICATION OF STRUCTURAL STEEL MATERIALS:***

a. *Scope of fabrication and installation covers, fabrication and installation of various type of supports for cable tray, Junction box/Panel, Bus ducts etc. with angles and channels of different size.*

b. *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.*

c. *Any minor chipping as required as detailed in VOLUME-IA PART –I CHAPTER -XI, including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After installation of frames, supports the grouting of the same is in the scope of contractor.*

d. *If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost.*

e. *All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting.*

f. *A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.*

*1.13.8 **SCOPE OF CIVIL WORKS***

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

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

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

1.13.9.1 SCOPE OF WORK FOR LT BUSDUCTS

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

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

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

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

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

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

1.13.9.1.1 DETAILED SCOPE OF WORK FOR LT BUS DUCT

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

b) Modification if any required in the support structures due to site conditions, the same shall be carried out without any extra cost. (Pockets will be provided during casting in which anchor bolts will be grouted for supporting the

structures)

c) Carrying out required level of cleaning inside as well as outside of the bus duct for the purpose of conducting high voltage test before commissioning of the unit. Every bus duct piece has to be tested for IR value (for 415 Volts bus ducts) and both IR and HV test at rated voltage (For voltage levels above 415 Volts) before erection. This is in addition to the final IR value and HV testing before charging. After long shut downs, the IR value / HV tests will have to be carried out before charging.

d) Extension of embedment if required and erection of required supports structures as detailed in the drawing.

e) Tightening of all bolts in the joints and flanges by torque wrench to the approved pressure (Anti oxidation compound will be used for joints which will be arranged by contractor)

f) Conducting air-tightness test after erection to meet the requirement of BHEL/Customer Standards.

g) Rectification of leakage, if any without any extra charges- For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, rotameter etc. at their cost. Contractors shall tap the air from nearest Instruments air tapping point available at site.

h) Fixing of Space Heaters terminal to junction box, taking through rigid/flexible conduit pipe, Fixing of flexible joints, seal off bushing, rubber bellows, CTs wiring, conduit / GI pipes breather tapping etc after testing.

i) Fixing of Current transformers and wiring from CT terminal to junction box / Marshalling box, taking through rigid/flexible conduit pipe.

j) Fixing of Space Heaters and wiring from Space Heaters terminal to junction box, taking through rigid / flexible conduit pipe

k) Carrying out minor repair, rectification of enclosure and conductors if it has happened during transit without any extra cost.

l) Arranging all T&P material handling equipment required for erection, except those arranged by BHEL.

m)Calibration of all inspection, measuring and test equipment (IMTEs) before using.

n) Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.

o) Presentation of necessary log sheets, protocols, test certificate as per Field Quality Plan (FQP) and getting them signed by BHEL / Customer Engineers, and submitting the same to BHEL as per the instructions of concerned BHEL Engineer.

p) Maintaining the equipment after commissioning till taken over by customer

q) Milli volt drop test is to be carried out for all bolted joints

r) Carrying out final painting as per the standard color codes recommended by BHEL including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer scope of painting).

1.13.9.2 SCOPE OF WORK FOR LT SWITCHGEAR 415V - POWER MOTOR CONTROL CENTERS /

MCC / DISTRIBUTION BOARDS, ECP AND OTHER CONTROL PANELS:

a) LT MCCs are simple module type with isolators and fuses. However, some of the MCCs are Double Front draw out type consisting of circuit breakers unit, contactors/starter fuse switch units, MCB etc. arranged in multi-tier construction.

b) The scope of work shall include receipt of panels, accessories & spares including rubber mats from site stores/yard, inspection, handling of accessories between stores and erection location, storage, erection of accessories, fabrication and installation of base frames wherever required, testing commissioning, touch up painting and maintenance up to handing over.

c) The base frames shall normally be supplied along with the boards. These shall be aligned, leveled and grouted in position as per approved drawings. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If grouting bolts are required for the panel, the same shall be supplied by the contractor at no extra cost.

d) Wherever the base channels are not available, the same shall be fabricated, erected and painted at site. The material for this shall be supplied by BHEL. If base frame is to be fabricated, separate rate shall be paid on Tonnage basis.

e) For the panels to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted. The contractor shall carry out fabrication and erection of these support structures. Separate rate shall be paid on Tonnage basis for fabrication and erection of support structures.

f) The MCC's will be located in MCC room at any elevation in the Power house, as per plant layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.

g) Panels will be delivered in different shipping sections. The contractor shall set each section of equipment on its foundation or supporting structures and assemble the panels as required. Necessary interconnection of busbar, inter panel wiring, etc. will have to be done by the contractor.

h) Generally the panels shall be supplied with complete Relays/ Instruments and other Components mounted and wired. However, if necessary, dismantling of the existing Relays / Instruments / Components, making minor modifications in wiring to suit operating conditions, mounting and wiring of new Relays/ instruments / components shall be carried out without any extra cost. Mounting and wiring of any instruments, meters, relays, push buttons, indicating lamps, contactors etc. if

supplied loose for safety in transit, shall also be included in the scope of the job. Replacement of defective / damaged components shall be carried out by contractor. The replacement shall be arranged by BHEL if the defect was brought to BHEL's notice immediately after issue of material from BHEL stores. The damages occurring during commissioning/ testing also would be replaced by BHEL. If the defect / damage has occurred during erection, the replacement shall be arranged by contractor. However, if any major wiring modification is involved inside the panel, the same shall be carried out at extra cost. The decision of BHEL Engineer shall be final in respect of above extra works.

i) The contractor shall do touch up painting of switchgear panels wherever necessary. This includes supply of paint also.

j) The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc. with well experienced Engineers / Technicians.

k) MCC / PCC incomer bus shall be connected to main source / PCC of customer. The contractor shall co-ordinate for proper connection at both ends.

l) Erection of Resistance box of DC drives shall be part of erection of DC starter panels.

m) Scope of work shall include drilling of bottom gland plates for cable entry for all the cables to be terminated on the panel, as per requirement.

n) Contractor shall co-ordinate with other cable-laying agency for proper cable termination.

o) The contractor shall close unused opening at the panel bottom plate with suitable material in consultation with Site Engineer as part of panel erection.

p) Rubber mats for Switchgear shall be supplied by BHEL, and these shall be laid, wherever required, by the contractor.

q) If panels are supplied with monitor, printers, furniture, controller etc. or any loose items or equipments, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items unless specifically indicated in the BOQ.

r) The scope of work shall include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels. All T&P, Material handling equipment including cranes and Relay Testing/ HV Testing Calibration equipment/ Instruments shall be arranged by contractor. All testing and calibrating instruments brought by contractor shall be with valid calibration certificates. The contractor shall carry out testing and commissioning works with their own testing equipments and testing teams. Testing shall be done under the supervision of BHEL/Customer Engineers.

s) BHEL shall provide vendors' support for commissioning of proprietary type of microprocessor based instruments, protection relays which requires software loading and programmer etc. However overall responsibility lies with contractor and

the contractor shall provide all support like manpower, standard T&P, instruments etc. for calibration and commissioning of above proprietary type instruments.

t) In certain cases, Switchboards incomer bus shall be connected to bus ducts, through adapter box. The contractor shall co-ordinate for proper bus bar connection. If any modification is required in the bus conductor for matching bus duct, bus bar the same shall be carried out without extra cost.

u) The commissioning of Switchgear shall also involve the trial runs and commissioning of all connected equipment like servomotors and drives etc. The contractor will have to keep his people round the clock, if necessary during the trial runs and promptly take action for any repair, checks and rectification etc. required in the equipment erected by him. (Separate rate shall be paid for commissioning of associated electrical drives as per Rate Schedule only once for an equipment). Contractor shall re-commission the equipments once commissioned by him in case a need arises. Contractor will not be paid commissioning charges more than once for same equipment. Commissioning engineers/ supervisors with other technicians, helpers as required will have to come in shifts during commissioning of plant as per BHEL's requirement.

v) All testing Instruments / Equipment deployed to site shall be calibrated before putting the same into service. A copy of calibration certificate shall be submitted to BHEL Engineer for his verification and approval.

w) Contractor shall prepare all erection / commissioning log sheets, protocols / test certificates as per field quality plan, get it signed by the concerned BHEL/ Customer Engineer and submit the same to BHEL Engineer as per his instruction.

x) The contractor shall maintain the charged and commissioned equipment till the same is taken over by customer.

y) If any removal / Re-fixing of contactors / relays become necessary for the completion of the system, the same shall be done by the contractor at no extra cost.

z) Contractor shall put his watch and ward for the equipment under his custody and erected in location against theft and damage by other agencies working on the same area.

aa) Any loose supplied items like lamps, lens, contactor, fuse/relays/instruments etc. missed from the custody of the contractor shall be replaced by the contractor at no extra cost.

bb) Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Variations in depth, height or weight of the panel shall not be considered for payment. Any variation in length within ±20% shall not be considered for payment. If the panels have any variation in length beyond ±20% as compared to actual length indicated in the BOQ, payment shall be considered proportional to the length of the panel only.

cc) BHEL shall provide EOT cranes for the purpose of shifting the panels within the PH building as sharing basis at free of cost. However , the contractor shall arrange operator and other T&P.

1.13.9.3 BATTERY AND BATTERY CHARGER

a) *The charger and batteries are of heavy duty type, capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden stands. Tentative details are given in the BOM.*

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

c) *Lump sum shall be quoted for Erection and commissioning of Battery. No additional payment shall be made for any variation in the number of cells. The rate quoted for erection of battery will include the following works.*

1.13.9.3.1 SCOPE OF WORK FOR BATTERY

a) *Collecting the batteries and all the accessories like cable connectors, inter cell connectors, equalizing connectors, rack insulators, fuse box, loop cables etc. from stores and assembling on the racks and fixing all loose supplied items as per drawings.*

b) *Filling the individual cells with Acid / Alkali – if applicable.*

c) *Arranging suitable resistive load banks for charging and discharging during charging and discharging cycles.*

d) *Arranging manpower in shift during battery charging and discharging cycles that may be carried out round the clock as per the code of practice, and conducting other routine tests as per IS under the supervision of BHEL Engineer / Vendor Engineer.*

e) *Modifications or changes if any for the loose supplied items or any minor changes in wiring.*

f) *Arranging necessary tools, T&P, Testing equipments required for erection and commissioning of the battery.*

g) *For laying and termination of cables of battery/ battery charger system, separate rate shall be applicable as per rates in Rate Schedule.*

1.13.9.3.2 SCOPE OF WORK FOR BATTERY CHARGER PANELS

The scope of work will be in line with scope of work for electrical control panels, as detailed under Clause 1.13.9

1.13.9.4 SCOPE OF WORK FOR CABLES

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

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

c) Unit rates shall be on meter basis. Unit rate quoted for cable shall cover laying, drilling of holes on the gland plates of the panels / JB or Enlargement of cable entry holes by tapping or any modification required fixing of cable glands, fixing of glands, ferrules termination, and providing tag plates and dressing.

d) Unit rates quoted for cabling shall also include supply of clamping / dressing materials such as Aluminium / GI strips and PVC ties, PVC wire marker sleeves, tag plates, lugs upto 2.5 sq. mm. apart from the work mentioned above. The lugs being used shall be of standard make and shall be procured after getting prior approval of the brand from BHEL engineer. Usage of any other lugs shall entail replacement of the lugs by the contractor at his risk and cost. Supply of above material shall conform to the specification detailed in Volume-IA Part-II Chapter-3. Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.

e) For single core Power cable, fixing of Trefoil clamps shall be treated as part of laying work.

f) If the cables are to be routed on steel angles as per site condition, steel angles will be supplied by BHEL.

g) The contractor shall carry out cable dressing and clamping for all the cables laid by him. However, if cables like illumination cables or any other cables of lesser quantity for which no separate trays have been allotted and are to be laid on the same trays, the contractor shall do clamping of such cables also along with the cables laid by him.

h) Single core cable used for three phase AC power shall be clamped in tre-foil cable at the time of laying itself.

The unit rate quoted for cable laying shall also cover the following works.

a) Enlargement of cable entry holes, if necessary, by chipping/tapping or any modification required fixing of cable glands

b) Reaming and relocating holes at actual point of entry of cable or conduit in terminal boxes, outlet boxes, pull boxes etc. cleaning off the debris/trapped material from conduit/ducts.

c) *In case any existing structure is affected/damaged due to installation work of cables the contractor shall repair the same to the satisfaction of Site Engineer*

d) *However any major modification like drilling, tapping etc. are involved in fixing of glands in JBs and Terminal boxes same shall be considered as extra on man hour rate basis as per extra works clause.*

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

1.13.9.4.1 CABLE TERMINATION

a) *The scope of termination shall include termination of cables on various panels / JBs / Push buttons etc. installed by others also. The contractor shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required.*

b) *Re-termination if required during testing / commissioning shall be carried out without additional cost.*

c) *Scope of termination shall include supply of insulating sleeves. The sleeves shall be fire resistant and long enough to over pass conductor insulation.*

d) *Contractor shall arrange all type of termination and crimping Tools / equipments required for the connections / terminations.*

e) *Contractor should use sleeve printers for printing sleeve as wire markers. Cut ferrules will not be permitted to be used. Cross ferruling shall be done for all wire terminations.*

f) *After cable terminations, the debris shall be removed then & there*

g) *Necessary lugs above 2.5 sq. mm shall be supplied by BHEL free of cost.*

h) *Separate rate shall be paid for termination of higher size cables. Such cables will be indicated separately in the BOQ/ Rate Schedule.*

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

1.13.9.5.1 CABLE TRAYS

a) *Scope of cable tray works covers erection various sizes of ladder & perforated trays with tray accessories such as bends(vertical and Horizontal), tees, cross, reducers, coupler plates, fasteners etc.*

b) *The scope of erection shall also cover erection of all type of trays and its accessories such as coupler plates / fixing plates, anchor bolts, fasteners. Tee, Reducers, Bends (vertical and Horizontal), cross etc,*

c) *If accessories such as Tees, Reducers, Bends (vertical and Horizontal), cross not supplied, same shall be fabricated wherever required, from the straight Trays. The accessories supplied may be modified to suit site routing as part of work.*

d) *The scope also covers making offsets by means of cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.*

e) *The unit rate for erection of trays shall be on meter basis which includes erection of trays and accessories, fabrication of trays accessories and modification of straight trays, if required.*

f) *No separate rate shall be paid for any fabrication of tray accessories or any modification on straight trays.*

g) *If trays covers are supplied same shall be erected after completion of cable laying and no separate payment will be made for fixing these covers. GI strip clamps are to be used for fixing the tray covers.*

h) *Welded Joints of GI trays shall be painted with cold galvanizing primer/ paint. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.*

i) *Cable tray mounting structure shall be welded to the plate inserts or to steel structural beams / members. Welding of cable tray mounting structure to steel structural beams / members shall be done with prior approval of Customer / BHEL Engineer.*

j) *Cable tray tag number shall be neatly painted on the cable tray.*

1.13.9.5.2 RIGID & FLEXIBLE CONDUITS

a) *Cables shall normally be laid on cable trays. However, in case of shorter routes where trays are not possible, suitable GI pipe / flexible conduits shall be used as per instruction of BHEL Engineer.*

b) *The scope of works for flexible conduit includes drilling of the holes on the plates, fixing of the end connectors, providing suitable supports and fixing tag marks wherever specified as required by BHEL. The supply of suitable clamps, fasteners and tag plates are in contractor's scope.*

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

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

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

c) *Payment for fabrication and fixing of supports shall be on tonnage basis.*

d) *The contractor shall close all unused holes on the gland plates using GROMMET or other suitable material issued by BHEL, within the quoted rate.*

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

f) *If any intermediate JBs are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works. Equivalent Unit rate shall be paid for installation of such JBs. Decision of site engineer will be final regarding the equivalent rate.*

1.13.9.7 SCOPE OF WORK FOR FABRICATION & INSTALLATION OF STEEL MATERIALS

a) *Scope of steel fabrication and installation covers, fabrication and installation of various types of supports for cable tray, Junction Box / Panel, busducts etc. with angles and channels of different size.*

b) *The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL.*

c) *Fabrication shall be carried out by the contractor as per schemes in consultation with site engineers.*

d) *Any minor chipping as required including supply of all cement, sand etc. as required for grouting of supports are in the scope of contractor, the same shall be carried out at free of cost. After installation of frames, supports the grouting of the same is in the scope of contractor.*

e) *Supply of all cement, sand etc. required for grouting of supports is in the scope of contractor.*

f) *All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting.*

g) *A composite unit rate shall be quoted for fabrication and installation of steel, on tonnage basis. The unit rate shall be paid on tonnage basis and no rate shall be paid for the erection of fabricated items i.e. the rate quoted for the steel material includes fabrication and installation. All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting.If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost. The above rate shall include supply & fixing of fasteners, supply & painting of paints, supply & grouting of grouting material as required.*

1.13.9.8 SCOPE OF WORK FOR ASH LEVEL INDICATOR:

a) *Scope of Ash level indicator consists of erection of transmitters (electronic unit), PTFE wires, probes (for high and low level sensing), flexible conduits etc. All PTFE cables shall be routed through GI flexible conduits.*

b) *The unit rate quoted for each set consists of erection of transmitters (electronic units), fixing of probes, laying and termination of PTFE cables through conduits, clamping of flexible conduits etc. The unit rate also covers supply of metallic clamps, lugs etc. Lumpsum rate shall be quoted for each set and no separate payment shall be made against erection of any individual item.*

c) *If any mounting frames are required for insulation of transmitters same shall be carried out on tonnage basis as applicable for other fabrication and erection.*

1.13.9.10 SCOPE OF ABOVE GROUND EARTHING & LIGHTNING PROTECTION

a) *Earthing scope also covers, earthing of all cable trays, metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, Transformer, Busducts, panels, motors, JB, push button boxes etc as required . All gates of fences shall be connected to earth flat with copper flexible, supplied by BHEL. No separate payment would be made for connecting copper flexible.*

b) *Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carry out rest of the earthing system work.*

c) *Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing material shall be paid on meter basis if appearing in the BOQ.*

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

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

1.13.9.11 LIGHTNING PROTECTION SYSTEM INSTALLATION

The scope of works for lightning protection system includes installation of vertical air terminations, Horizontal conductors, vertical risers, down conductors, test links, supply of saddles & clamps, minor civil works etc.

Horizontal and vertical down conductors: the horizontal conductors shall be installed on the top of the building with suitable clamps/ saddles arrangements. The horizontal conductor shall be connected with down conductors which in turn will be connected to risers through test links. Both horizontal and down conductors shall be supported on the clamps/saddles and spacers which will be fixed on the walls/columns or on top of the parapet walls.

The scope of work for horizontal and vertical conductor shall include supply of supports, clamps, saddles, spacers, Anchor fasteners etc.

Test links shall be installed in the vertical down conductors at ground level as shown in the lightning protection drawings. Supply of GI fasteners like washer /bolt/ nut required for fixing test link and connecting test link to earth electrodes through GI flat by welding also is part of the scope.

Vertical air terminations: the vertical air terminations shall be located in different locations of the buildings. The vertical air terminal shall mostly be fixed on the top of peripheral wall using a GI base plate of size 150x150x6 mm . The vertical air terminal shall be grouted on the wall and minor civil works required for grouting the air terminals including supply of grouting materials are in the scope of contractor.

Supply of base plates, and related civil works, grouting and supply of grouting materials are part of the scope for vertical air terminations.

1.13.9.11 SCOPE OF CIVIL WORKS

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

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

c) *More details regarding scope of civil works are given in the respective equipment erection.*

d) *No separate payment will be applicable for above civil works.*

1.13.9.12 SCOPE OF CALIBRATION

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

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

c) *All testing instruments shall have calibration certificate issued by recognized / accredited agencies.*

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

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

1.13.9.13 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR

1.13.9.13.1 All types of LT drives

a) *Cable identification, checking and measuring insulation resistance (IR).*

b) *IR value of motor, measurement of winding resistance etc.*

c) *Dryout all the motors if required to improve IR value.*

d) *Limit switch and torque switch setting*
e) *Calibration of Electronic cards, modules etc. and fixing the same if supplied as loose item.*
f) *Checking direction of rotation of motors and testing and commissioning from local as well as remote.*
g) *Attending to any defects till the handing over of the unit to customer.*
h) *Replacing defective components like limit switches, electronic cards etc.*

1.13.9.13.2 Skid mounted Panels.

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

1.13.9.13.3 Hoist:

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

1.13.9.13.4 ESP Heating Elements and Thermostats

1) *All heating elements shall be fixed by the mechanical contractor.*
2) *Unit rate quoted for heating element includes routing the extension cables through flexible conduits, dressing, terminations and checking of the heating elements.*
3) *Unit rate quoted for thermostat and other standard heating elements covers only checking of elements/thermostat*

The scope of work includes

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

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,

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.

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

TESTING, PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

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

1.15.1 ***SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR***

All types of Drives and Generator

a- Cable identification, checking and meggering.

b- IR value of Generator, motor, measurement of winding resistance etc.

c- Dry out all the motors if required to improve IR value.

d- Checking direction of rotation of motors and testing and commissioning from local as well as remote.

e- Checking the bushing and HV test / Tan delta test

f- Attending to any defects till the handing over of the unit to customer

ESP Transformer

a- Dry out of transformers (Oil filtration) till achieving desired BDV, IR Value, Calibration of oil temperature gauges, checking of breather gauge, Relays, HV Test etc. i.e. scope of commissioning of ESP Transformer shall be in line with transformers erected by the contractor.

b- Replacing defective components like temperature gauges, breather glass etc.

c- Attending to any defects till handing over of the unit to customer by BHEL

1.15.2 ***SCOPE OF PRE-COMMISSIONING/ COMMISSIONING AND POST COMMISSIONING WORKS:***

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

a. Trial run of various equipment.

b. Light up of boiler.

c. Boiler chemical cleaning.

d. Turbine barring gear.

e. Steam blowing of piping.

f. Turbine rolling.

g. Safety valve floating.

h. First synchronisation

i. *Heavy oil firing and synchronisation.*

j. *Coal firing.*

k. *Trial Operation / Full load.*

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

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

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

1.15.2.4 *The mobilization of testing team shall be planned in time and shall be undertaken round the clock. Contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost will be recovered from contractor.*

1.15.2.5 *Prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope*

1.15.2.6 *Any rework/rectification/modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost. During commissioning, any improvement rework / rectification /modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.*

1.15.2.7 *Minimum requirement of Man Power for testing/checking works shall be as follows:*

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

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

1.15.2.8 All T&P / instruments required for testing including the Generator Circuit Breaker (21 KV) are to be arranged by the contractor.

1.15.2.9 All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.

1.15.2.10 The scope of commissioning assistance to be provided by the contractor will cover the equipment/drives erected by the mechanical contractors as detailed in the BOM.

1.15.2.11 All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL/ its client free of hire charges. However contractor has to take proper care of the equipment issued to him.

1.15.2.12 All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.15.2.13 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre-commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.15.2.14 It shall be specifically noted that the contractor and employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers / customer officials. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers/supervisors.

1.15.2.15 In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost. If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.

1.15.2.16 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.15.2.17 Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

1.15.2.18 After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools and supervision as part commissioning assistance till handing over of sets to customer.

1.15.2.19 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.

1.15.2.20 The contractor shall carryout any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.15.2.21 It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, even if commissioning of equipments is delayed due to reasons not attributable to the contractor.

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 scope of work shall also include supply and application of final painting of all the erected equipments as required and specified for the components of boiler and its auxiliaries as per the painting specifications of customer / BHEL.

1.16.2 In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.

1.16.3 All the exposed metal parts of the equipments including busducts, transformers, structures, etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL / Customer official.

1.16.4 Paint shall be applied by brushing or by spray painting as per the instruction of BHEL Engineer. Spray painting gun and compressed air arrangement has to be made by the contractor himself. It shall be ensured that brush marks are minimum.

1.16.5 If needed and insisted either by BHEL / Customer in certain cases, spray painting has to be carried out within the Quoted rates.

1.16.6 Before applying the subsequent coats the thickness of each coat shall be measured and recorded with BHEL / Customer.

1.16.7 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.,

1.16.8 The scope of painting includes application of colour bands, lettering the names of the systems equipments; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.

1.16.9 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

1.16.10 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification will be issued during execution / relevant BHEL document/ customer's specifications.

1.16.11 The actual colour to be applied shall be approved by the customer before starting of actual painting work.

*1.16.12 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.*

1.16.13 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.

1.16.14 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.

1.16.15 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL/ Customer.

1.16.16 PRESERVATION / TOUCH UP PAINTING

1.16.16.1 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.

1.16.16.2 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.

1.16.16.3 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.

1.16.16.4 Touch up painting only is generally required for control panels, and full painting shall be required only for specific equipment such as Busducts, Transformer etc. as per the scope of erection.

1.16.16.5 All damaged painted surfaces shall be cleaned and coated with two (2) coats of primer followed by a finishing coat of approved colour.

1.16.16.6 All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.

Painting Details

Sl. No	Description	Painting Details
01	16 MVA, 11/3.6 KV UNIT AUX. TRANSFORMER	SHADE 631 OF IS : 5 (EPOXY PRIMER & POLYURETHANE FINISHING PAINT)
02	80 MVA, 400 / 11.5 – 11.5 KV, 3-PHASE STATION TRANSFORMER	631 OF IS : 5 LIGHT GREY SHADE
03	240 MVA 400 / 21 KV I-PHASE GENERATOR TRANSFORMER	OUTSIDE FINISHING PAINT SHADE 631 OF IS : 5
04	BUS DUCT	OUTSIDE SURFACE OF BUS DUCT : As per IS : 5 SHADE No. 631
05	34.5 MVA, 21 / 11.5 KV UNIT TRANSFORMER (UT)	OUTSIDE PAINT SHADE 631 OF IS : 5 POLYURETHANE TYPE

VOLUME 1A - PART- II Chapter-1

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

2.1.1 INSTALLATION, TESTING & COMMISSIONING IN GENERAL:

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

Completion

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

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

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

2.1.2 SITE TESTS AND CHECKS

2.1.2.1 General

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

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

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

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

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

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

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

2.1.2.2 Trial Run Test

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

2.1.2.3 Acceptance Test

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

2.1.3 BUSDUCTS – ISOLATED / SEGREGATED PHASE BUSDUCTS

2.1.3.1 HANDLING AND STORAGE

General

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

2.1.3.2 INSPECTION AT SITE :

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

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

2.1.3.3 HANDLING DURING ERECTION :

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

a. *While lifting enclosure assemblies manila ropes are passed round the bus duct enclosure near the support channels.*
b. *All shipping steel clamps are to be tightened and bus bars do not slip out while handling, if the bus bar is assembled in the enclosure.*
c. *While inserting and mounting the bus bar in the enclosure care is taken that the bus bar does not hit and damage the insulators.*
d. *Eye bolts are used while lifting the cubicles.*

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

2.1.3.4 Caution

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

2.1.3.5 HANDLING OF BUS DUCT.

Handling from delivery station to power station stores:

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

2.1.3.6 DURING UNPACKING, HANDLING AND STORAGE

DO's

1. *Check all the packings for any damage during transit.*
2. *Open the packings carefully.*
3. *Verify material as per shipping list and report any shortage/damage immediately.*
4. *Keep material in original packings unless required for erection.*
5. *Ensure that Manila ropes are used for lifting the busduct.*
6. *Check the tightness of shipping steel clamps while lifting busduct assembly with busbar in position.*
7. *Ensure that CTs, LAs, capacitors, N.G. transformer, grounding resistor, fuses, insulators, wall bushings, moulded and rubber items and flexibles are stored in well ventilated area.*

DON'Ts

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

2.1.3.7 DURING ERECTION & COMMISSIONING :

DO's

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

DON'Ts

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

2.1.3.8 ERECTION INSTRUCTIONS

A. Packing and Shipping

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

assembly and erection are furnished separately.

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

B. Marking :

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

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

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

2.1.3.9 PRE LAYOUT SURVEY

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

2.1.3.10 PROVISION OF FOUNDATION BOLTS & EMBEDDED ITEM

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

2.1.3.11 SEQUENCE OF ERECTION

Normally the following sequence of erection is recommended.

A. Erection of steel work :

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

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

B. Erection of Enclosures :

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

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

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

C. Handling of Busducts :

For handling of busducts specified instructions should be followed.

D. Sequence of erection-enclosure assemblies:

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

E. Indoor Portion:

(a) Neutral Side

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

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

(b) Line Side

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

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

F. Outdoor Portion:

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

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

current transformers, flexible connection, disconnecting link and rubber bellows.

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

G. Busbar Joints :

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

H. Cleaning of Busduct

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

I. Inspection of windows, covers, etc.

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

2.1.3.12 BUSBAR BOLTED JOINTS

A. Aluminium to Aluminium Joints (Un plated)

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

B. Aluminium to Copper Joints :

Cleaning of Aluminium surface (Unplated)

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

Cleaning of copper surfaces (unplated)

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

Cleaning of copper aluminium surfaces (unplated)

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

C. Aluminium to Copper Joints using bimetallic strip

For cleaning of aluminium and copper surfaces follow instructions given under

2.2.3.12 A&B above. Apply jointing compound to aluminium and copper surfaces.

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

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

D. Cleaning of copper surfaces (plated)

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

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

2.1.3.13 CONTACT PRESSURE

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

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

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

2.1.3.14 RECOMMENDATION FOR WELDED JOINTS

A. Circumferential weld circular section :

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

Welding conditions M.I.G. Process

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

B. Tubular Conductors :

Tubular Conductors are used in tee-off connections.

Welding conditions M.I.G. Process

Filler wire	*:*	*1.6 mm dia (NG 21 with 5% silicon)*

Angle	:	*10° to 15° Forehand*
Cleaning	:	*Degrease and scratch brush*
Setting	:	*215A to 275A, 22 to 2 Volts*
Gas supply	:	*50 Cu. ft/hr argon*
Shield	:	*5/8" dia*
Purity	:	*99.98%*

C. Enclosures

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

Welding conditions M.I.G. Process :

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

D. Drain valve and welding :

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

2.1.4.1 WELDED BUS ENCLOSURE JOINTS

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

2.1.4.2 WELDED JOINTS OF SHUNTS

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

2.1.4.3 DRAIN VALVE WELDING (IF APPLICABLE)

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

2.1.4.4 FIXING OF NEOPRENE SEAL :

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

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

2.1.4.5 EARTHING OF ISOLATED /SEGREGATED PHASE BUSDUCT AND CUBICLES

A. General

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

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

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

B. Cubicle earthing :

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

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

2.1.4.6 SITE TESTS ON ISOLATED /SEGREGATED PHASE BUSDUCT

A. Physical Checks:

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

B. Cleanliness:

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

C. Power Frequency High Voltage Test

Preparation:

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

a. *Generator terminals*
b. *Unit auxiliary transformer terminals*
c. *Generator transformer terminals*
d. *Neutral grounding transformer HV terminal*
e. *Lightening arresters*
f. *Capacitors*

g. Potential transformer.

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

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

During the test, ensure the following

a. The generator rotor is kept stationary.

b. H.V. Circuit breakers on system side are kept in the open position.

D. Test Voltage:

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

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

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

Table - 1

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

E. Meggar-Checks:

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

F. Application of Test Voltage:

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

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

Test conducted on date..... Site .....

Power Frequency high voltage test :

Instrument .....

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

2.1.5 TRANSFORMER

2.1.5.1 INSTALLATION

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

2.1.5.2 INSPECTION

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

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

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

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

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

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

2.1.5.3 UNLOADING

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

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

2.1.5.4 STORING

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

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

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

2.1.5.5 LIFTING

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

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

2.1.5.6 CHECK POINTS BEFORE STARTING AND DURING ERECTION

a. Check points before starting erection.

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

b. Check-points during erection:

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

i. *Fire-fighting equipment shall be available at the oil-treatment equipment as well as at work on and adjacent to the transformer.*

ii. *Welding work on or adjacent to the transformer shall be avoided, but if this is not possible, the work shall be supervised by fire-protection personnel.*

iii. *Smoking on or near the transformer shall not be allowed.*

iv. *Transformer tank, control cabinet etc, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station*

v. *Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened.*

vi. *All loose objects, tools, screws, nuts etc. shall be removed from the transformer cover before opening the connection and blanking lids.*

vii. *All loose objects (tools, pencils, spectacles etc.) shall be removed from the boiler- suit pockets etc. before starting the work through man-holes.*

viii. *Tools to be used inside the transformer e.g. for tightening of screws-joint-shall be fastened to the wrist or another fixed point by means of cotton tape or string.*

ix. *Tools with loose sleeves and tools with catches must not be used at work inside the transformer.*

x. *Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer.*

xi. *Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it.*

xii. *All components despatched separately should be cleaned inside and outside before being fitted.*

1. A Transformer is best protected form damp hazard by circulating warm, dry, de-aerated oil through it until it temperature is 5 C to 10 C above ambient. This should be done before allowing external excess to the interior of the tank. The warm oil should be circulated all the time transformer is open to atmosphere.

xiii. *Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints.*

xiv. *The active part (core and winding) should be exposed to the surrounding air as short time as possible. Open therefore only one blanking plate or connection lid at a time for remounting of bushing, valves etc.*

xv. *Objects which-despite all precaution are dropped inside transformer / reator, must absolutely be brought up form the equipment.*

xvi. *Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.*

2.1.5.7 ASSEMBLY

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

2.1.5.8 OIL FILLING

The following procedure is recommended.

i. *Close and blank the valve to isolate the conservator from main tank. Fill the oil in transformer under vacuum up to Buchholz level as per instructions given elsewhere.*

ii. *After filling the oil in transformer and breaking the vacuum, oil can be filled in the conservator either through reactor or by drain valve.*

iii. *Remove the inspection cover (ii) provided on the side of the conservator and check the air cell assuring that it is inflated. The air must remain in fully inflated condition during oil filling operation. If the air cell is found deflated fit the inspection cover and inflate the air cell with dry air / nitrogen gas to 0.035kg/sq.cm max. A gauge may be put by removing plug. After filling close these connections.*

iv. *Remove air release plugs provided on top of the conservator.*

v. *Slowly pump the oil through main reactor / drain valve. Temporarily stop filling operation when oil starts coming from opening after ensuring that no air bubbles come out through these air release holes. Fit the two air release plugs.*

vi. *Continue oil filling till oil start coming from air release plug stop oil after ensuring that no air bubbles come out. Fit the plug.*

vii. *Now release the air pressure held inside the air cell from point and continue oil filling until magnetic oil gauge indicates 35 deg. C level.*

viii. *Remove oil pump and connect air cell to breather from point. Also remove pressure gauge and put plug.*

ix. *The system is now properly filled. Air release plugs are fitted in normal operation.*

2.1.6.1 EQUIPMENT FOR OIL-FILLING UNDER VACUUM

(i) *High-vacuum 2 storage oil filtration plant provided with thermostat-controlled oil heaters and vacuum-proof hoses with dependent vacuum pumping system for tank evacuation. Capacity: 6 kl/hr*

(ii) *Oil-storage tanks provided with silica-gel breathers and inlet / outlet valves for oil circulation. Recommended capacity 20kl*

(iii) *Vacuum gauges provided in filtration plant.*

(iv) Equipment for measurement of electric strength (BDV) of oil - 100 kv set.

(v) Equipment for moisture content of oil.

vi) Equipment for measurement of Resistivity and Tan delta at 90 C.

vii) Transparent vacuum-proof tubes for checking of oil-level during oil filling.

ix) Valves, fitting, gaskets etc.

(x) Dry nitrogen cylinders.

2.1.6.2 COMMISSIONING

Testing after Assembly of the Transformer

After the transformer/has been assembled at site, it shall be tested in order to check that it has not been damaged during transport and assembly to such an extent that its future operation will be at risk. Regarding the performance of the test, refer to the testing method as per standards. The results of the test shall be documented.

COMMISSIONING CHECKS

Sl. No	***DESCRIPTION***
1.	*Breather Silica gel (Blue when dry)*
2.	*Oil in the Breather housing cup.*
3.	*All valves for their correct opening and closing sequence.*
4.	*Oil level in conservator tank.*
5.	*Oil in cooling system.*
6.	*Oil level in bushings.*
7.	*Release air, wherever necessary.*
8.	*Cooling accessories (Pump motors, Fan motors etc.) for direction and O/L setting.*
9.	*Buchholz, oil level indicator, pressure gauges, thermometer, Temp. indicators etc.*
10.	*Neutral earthing.*
11.	*Earth Resistance of Electrodes.*
12.	*Earthing of bushing test tap.*
13.	*Check oil leakage for 24 hrs.*
14.	*Check Auxiliary circuit voltage (415 V)*
15.	*Calibration of OTI / WTI with hot oil.*
16.	*Check Working of WTI / RTD repeaters at control room.*
17.	*IR of core to earth.*
18.	*Die electric strength of oil PPM & Chemical analysis, specific gravity test*
19.	*IR tests on windings to earth and between winding*
20.	*Phase sequence test & vector group check*
21.	*Continuity test*

22. *No load voltage ratio on all tap position*
23. *Winding resistance in all taps*
24. *Tap changing at 415v 3 50 Hz supply in all three phases*
25. *TAN-DELTA test if quality check list calls for.*
26. *Dew point check for N2 Gas at the time of oil filling*

INSULATION RESISTANCE TEST

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

Note :-

(1) While checking these values no external, lightning arrestors etc should be in circuit.

(2) Special care should always be taken while meggering the transformer winding to ensure that there is no leakage in the leads.

(3) Megger voltage to be decided based on the voltage rating of equipment under test.

Oil Characteristics.

Take necessary precaution (regarding rinsing the bottle, cleaning hand, air bubble etc) while withdrawing the samples, Each sample should be free of air bubbles

and should not be tested when it is hot. The sample should satisfy IS:1866.

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

Tests on CT

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

Potential Transformer Tests

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

On Load Tap changer

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

Note

1) While operating the mechanism on Electrical Control, check once again limit switches, step by step contractor, over running device etc. for their actual

operation and prove that they are functioning properly.

2) For More details Please refer Respective Manuals.

2.1.7 GUIDELINES FOR ERECTION OF HT SWITCHGEAR PANELS

2.1.7.1 Erection

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

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

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

2.1.7.4 THE FOLLOWING POINTS SHALL BE CHECKED UP DURING ERECTION

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

Operation of relays and meters by secondary injection.

15. *AC/DC supplies for panel*

    Final relay settings as per customer requirements.
16. *Tightness of terminal connections for HT & LT connections.*
17. *Opening operation of breaker, manually and electrically.*
18. *Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.*

2.1.7.5HT SWITCHGEAR TESTS

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

2.1.8 LT SWITCHGEAR PANELS

1. Erection

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

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

1.3 All the boards will be delivered in sections. Necessary interconnection of busbar,

bolting of panels, left out panel / inter panel wiring, etc. will have to be done after assembling the panel.

2. Checks during erection

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

3 LT Switchgear tests

1. *IR test*
2. *Measurement of contact resistance for LT breakers*
3. *Test to prove inter changeability of similar parts (including breaker module*
4. *Testing of relays as per supplier's commissioning manual.*
5. *Testing and calibration of all meters.*
6. *Operation of all relays by secondary injection method.*

7. *Testing of CT polarities and CT ratio by primary injection test.*
8. *Measurement of kneepoint voltage and secondary resistance for CTs used for differential protection*
9. *IR and voltage ratio test for PTs*
10. *Functional test of all circuit components for each panel / feeder*
11. *Test to prove closing / tripping operation at minimum and maximum specified voltage in test and service position*
12. *Check for drawout test and service position of breakers for all feeders*
13. *Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.*

2.1.9 BATTERY AND BATTERY CHARGER

1 Battery Checks

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

2 Battery Charger

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

10. *Checking and setting of all relays.*
11. *Check AC ripple in boost and float mode after charging.*
12. *Check polarity of cables connected to battery.*

3. Additional tests

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

2.1.10 GUIDELINES FOR CABLE LAYING

1) *In the plant building, substations, switchgear rooms, control rooms etc. Power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and structures as the case may be.*
2) *In case of multi-core cables of diameter up to 20 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of more than 300 mm.*
3) *Power & control cables installed along buildings and structures, ceilings, walls, etc. which are required to be protected against mechanical damage shall be taken in G.I. conduits.*
4) *GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends*
5) *In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be provided.*
6) *Entry of cables through trenches/tunnels into buildings shall be by means of one of the methods indicated in drawing as applicable for different buildings.*
7) *Cables laid exposed in racks/trays and routed through trenches/tunnels/basements etc. to individual drive/control devices etc. shall be taken in embedded surface exposed rigid GI conduits and or flexible conduits unless directly terminated to the equipment in the panels located, above trenches, tunnels or basement.*
8) *All cables routed along walls or in equipment rooms shall be protected by means of laying them through GI pipes or by providing sheet metal covers up to a height of 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.*

9) *Tray covers shall not be provided for the cable trays within trenches, tunnels and basements. Non-perforated type sheet steel covers shall be provided for the trays in the areas susceptible to accumulation of coal dust/atmospheric abuses etc.*
10) *Cable trays shall be supported on ISA 50x50x6mm MS/GI brackets. Brackets shall be welded to steel plate inserts in the trenches / tunnels or supporting channel angle / inserts in other areas.*
11) *Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.*
12) *For 415V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.*
13) *If required, a few numbers of cables in exceptional areas may be directly buried into the earth.*
14) *Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth as decided by Engineers.*
15) *At certain places where hazardous fumes / gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.*
16) *In corrosive atmosphere, PVC conduits shall be used for cables.*
17) *Single core cables, when pulled individually shall be taken through PVC pipes only.*
18) *Laying and installation of power, control and special cables shall generally conform to IS : 1255*
19) *The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).*
20) *In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.*
21) *Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.*
22) *Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of cable. The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS 1255.*
23) *All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable circuit schedule. Tags shall be fixed at both ends of cables (both inside & outside of panel) both sides of floor/wall crossings, every 25m spacing for straight runs or as specified by Engineer for easy identification of cable.*

24) *When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.*

25) *Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.*

26) *Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacing not less than one cable diameter of bigger diameter cable.*

27) *All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanised MS saddles / aluminium strips / nylon cable ties. Cables above 35mm diameter shall be clamped individually.*

28) *Control cables shall be laid touching each other and wherever required may be taken in two layers. All control cables shall be clamped with a common clamp/tie.*

29) *Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:*

    29.1 HT cables shall be laid in the top tier(s)

    29.2 LT power cables to be laid in the tray(s) below the HT cable trays.

    29.3 LT control cables to be laid in the Tray(s) next below to the LT power cable (trays)

    29.4 Special control cables including screened control cables to be laid in the bottom most tray(s).

30) *For vertical formations, the trays closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed. However, where there is no clear distinction of bottom / top trays, the order convenient for linking the horizontal and vertical formations shall be followed.*

31) *When it may not be possible to accommodate the cables as per the criteria indicated in the two clauses 29 & 30 indicated above, the following rules shall override the criteria. However, prior approval of the Engineer will be required. In hierarchical order:*

    31.1 Control cables are mixed up with the special control cables with clear minimum gap of 100 mm between them.

    31.2 LT power cables are mixed up with control cable with clear minimum gap of 150 mm between them.

    31.3 LT power cables are mixed up with HT power cables with clear minimum gap of 200 mm between them.

    31.4 LT power cables are mixed up with special control cables with clear minimum gap of 200 mm between them.

32) *In case of duplicate feeders to essential loads, the respective cables shall be laid through separate raceways. Alternatively, such cables shall be laid on the opposite sides of a trench / tunnel / basement.*

33) *For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanised.*

34) *For laying cables along concrete walls, ceilings etc. The cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using raw plus and MS flat spacers of minimum 6 mm thickness.*

35) *To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoop or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.*

36) *No single core cable shall pass through a GI conduit or duct except DC single core cables. AC single core cables shall pass through GT conduits/pipes in trefoil formation only.*

37) *In case of a 3 phase, 4 wire system, more than one single phase circuit, unless originating from the same phase shall not be taken in the same GI conduit.*

38) *Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for consideration by BHEL.*

39) *Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.*

40) *SUPPORT SPACINGS & CLAMPINGS*

Support spacing and clamping suitably provided and as required

41) *LAYING OF CABLES DIRECTLY BURIED IN GROUND*

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

42) *SUPPORT SPACINGS & CLAMPINGS*

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

Other Clamps

A. Power Cables:

Above 35mm OD

i) Horizontal runs : Individually clamped at 3000 mm Interval (max)

ii) Vertical runs : Individually clamped 3000mm intervals (max).

Upto 35mm OD

i) Horizontal runs : Collectively clamped at 3000 mm intervals (max)

ii) Vertical runs : Collectively clamped at 2000 mm interval (max)

B. Control Cables:

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

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

C. Spacing for cables supported along structure/ceiling

Clamping Spacing:

i) In horizontal runs : 750mm (max)

ii) In vertical runs : 750mm (max)

Spacing between cables : 30 mm (min)

Note:

a. Supports shall also be provided at each bend.

b. For any change in above spacing, prior approval of Engineer will be taken

43) CABLE TERMINATION AND JOINTING

a. When the equipment are provided with undrilled gland plates for cable/conduit entry into the equipment, drilling and cutting on the gland plate and any minor modification work required to complete the job shall be carried out at site and drawings shall be prepared and take engineer's approval before drilling holes. Cutting shall not be allowed.

b. Termination of cables shall be done as per termination drawings & interconnection diagrams furnished to the contractor. Looping of cores/wires at terminals as shown in interconnection diagrams is to be done.

c. All cable entries in the equipment shall be sealed after glanding the cables.

d. Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor.

e. Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals.

f. End sealing/termination of cables shall be done by means specified on the specification for terminations. The system shall be suitable for types of cable specified and complete with stress relief system.

g. Termination and jointing of aluminium / copper conductor power cables shall be done by means of compression method using compression type aluminium / tinned copper lugs.

h. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.

i. Cable joints shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer. In such cases, when jointing is unavoidable,

the same shall be made by means of specified cable-jointing kit, subject to BHEL's approval of Engineer shall be taken for deciding location of joint.

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

44) TESTING OF CABLES:

i. The contractor shall submit to the Engineer a checklist for testing and commissioning and the activities shall be carried out in accordance with the checklist.

ii. Testing and electrical measurement of cable installations shall conform to IS : 1255

iii. Prior to installation, cables shall be tested for :

- *a) Continuity of conductors*
- *b) Insulation resistance between conductors & earth*
- *c) Insulation resistance between conductors.*

iv. After installation cables shall be tested for :

- *a) Insulation resistance between conductors & iron*
- *b) Insulation resistance between conductors & earth*
- *c) Conductor resistance*
- *e) Capacitance between conductors & earth (for cables above 7C.1.3KV grade)*
- *f) DC high voltage test (for LT power cables of higher sizes interconnecting PCCs & MCC)*
- *g) Absence of cross phasing*
- *h) Firmness of terminations.*

2.1.11 TESTS FOR THE EQUIPMENT ERECTED BY MECHANICAL CONTRACTOR

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

a) Generator :

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

Following tests shall be carried out on the generators:

1. *Insulation resistance test and determination of polarization index value of:*
   - *Generator*
   - *Exciter*
   - *Resistance temperature detectors*
2. *Dielectric test*
3. *No load characteristics*
4. *Short circuit characteristics*

5. *Temperature rise at rated voltage, current, power factor and frequency.*
6. *Over-speed test*
7. *Calculation of efficiency*
8. *Phase sequence / voltage balance / current balance checks.*

Note :

a) *Vibration tests in the factory to be taken at 100% of synchronous speed and at 120% during over-speed test.*

b) *Vibration test at site to be taken at 100% of synchronous speed of the complete generator with its driver.*

9. *Instantaneous short circuit test (Optional).*
10. *Noise measurement test.*
11. *Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.*
12. *Temperature detector test*
13. *Measurement of DC resistance of winding*
14. *Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minutes (if applicable).*
15. *Measurement of shaft voltage.*
16. *Tan Delta test for generator bushing (If required).*

b) AC Motors

1. *IR test of stator and rotor windings.*
2. *Heating of both windings up to the permissible temp.*
3. *Checking/testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed.*
4. *Tightness of cable connection.*
5. *Winding resistance measurement of stator and rotor.*
6. *Checking continuity of winding.*
7. *Checking tightness of earth connections.*
8. *Checking space heaters and carryout heating of winding (if required)*
9. *Checking direction of rotation in decoupled condition during kick start*
10. *Measurement of no load current for all phases*
11. *Measurement of temperature of body during no load and load conditions.*
12. *Check for tripping of motor from local/remote switches and from.*
13. *Checking of vibration (if required).*
14. *Checking of noise level (if required)*
15. *Measurement of stator and bearing temperatures during load running (if applicable) for every half an hour interval till saturation comes.*
16. *Checking operation of speed switch (if there)*

17. *Checking of polarisation index of stator winding, R10/R1 by motorised megger (The value should not be less than 2.0) R60/10 absorption coefficient shall not be less than 1.5.*
18. *Dielectric test.*

c) DC Motors

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

2.1.12 CODES AND STANDARDS

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

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

IS The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to dates, relevant IS codes of Practice and Indian Electricity Act. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding. A list of applicable standards is given below for reference.

IS 3043 Code of practice for earthing

IS 3072 Installation and maintenance of switchgear

IS 5133 Box for enclosure of electrical equipment

IS 5216 Guide for safety procedure and practice in electrical work

IS 13947 Degree of protection provided by enclosures for low voltage switchgear and control gear.

IS 5216 Guide for safety procedures and practices in electrical works.

IS 800 Code of practice for use of structural steel.

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

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

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

2.1.13 TECHNICAL REQUIREMENT FOR ITEMS SUPPLIED BY THE CONTRACTOR.

2.1.13.1 GENERAL

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

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

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

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

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

2.1.13.2 FERRULES

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

2.1.13.3 TAGS

a) *Cables shall be provided with cable number tags for identification.*
b) *Cable tags shall be of durable fiber, aluminium or stainless steel sheets.*
c) *Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fiber 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 tagging's.*

2.1.13.4 ***FIRE STOP CABLE SEALING SYSTEM (AS APPLICABLE)***

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

2.1.14 GUIDELINES FOR ERECTION OF GI PIPES , SUPPORTS & ACCESSORIES

2.1.14.1 For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.

2.1.14.2 For equipment and devices having GI conduit entry arrangement other than standard GI conduit adopter, adopters shall be provided as required to enable the GI conduit to be properly terminated, between conduit end and motor T.B.

2.1.14.3 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.

2.1.14.4 The entire GI conduit system shall be firmly fastened in position. All boxes and fittings shall generally be secured independently from the GI pipes entering them.

2.1.14.5 Bends of GI pipes/conduits shall be made without causing damage to the pipes/conduits.

2.1.14.6 Occupancy of conduits shall not be greater than 40%.

2.1.14.7 The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanised steel.

2.1.14.8 Transportation and storage of cable drums shall generally conform to the requirements of IS: 1255.

2.1.14.9 All the cables shall be supplied to the contractor free of cost from BHEL / Customer's store / storage area. Transportation of cables from storage area to the work site shall be the responsibility of the contractor.

2.1.14.10 The cable drums shall be transported on wheels to the place of work.

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

VOLUME-IA PART- II CHAPTER -2

DATA SHEET

2.2.1 SPECIFIC TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

2.2.1.1 *Ferrules/ Fire stop cable sealing system / tags: As per relevant Clause elsewhere in the tender*

2.2.1.2 ***Tag***

a. *Material: Aluminium / Fiber / Stainless Steel*
b. *Markings : Engraving / Embossing / Printing*
c. *Size : As required.*

2.2.1.3 *Cable lugs of size 2.5 Sq. mm and below :Copper / Aluminium (crimping type)*

2.2.1.4 *Anchor fasteners for wall mounted cable trays / JBs*

2.2.1.5 *Insulation tape.*

2.2.1.6 *Paints required for primer & final coating and for protective coating.*

2.2.1.7 *Solder wire (Lead) -(60/40)*

2.2.1.8 *Panel sealing compound material (for cable entry from bottom / top of Panel).*

2.2.1.9 *Materials required for cable dressing. PVC wire marker sleeves and Tag plates*

2.2.1.10 *GI / aluminum flats for cable dressing*

2.2.1.11 *PVC cable ties*

2.2.1.12 *Welding electrodes, gases etc.*

2.2.2 Wastage Allowance:

Support installation : 1% by weight

VOLUME-IA PART- II CHAPTER -3

THE FOLLOWING ENCLOSED DRAWINGS ARE FOR INFORMATION ONLY

3a	Outline General Arrangement of Generator Transformer
3b	Part List for Generator Transformer
3c	Outline General Arrangement of Unit Transformer-
3d	Layout of S.P. Busduct
3e	Layout of I.P. Busduct

FIRST ANGLE PROJECTION

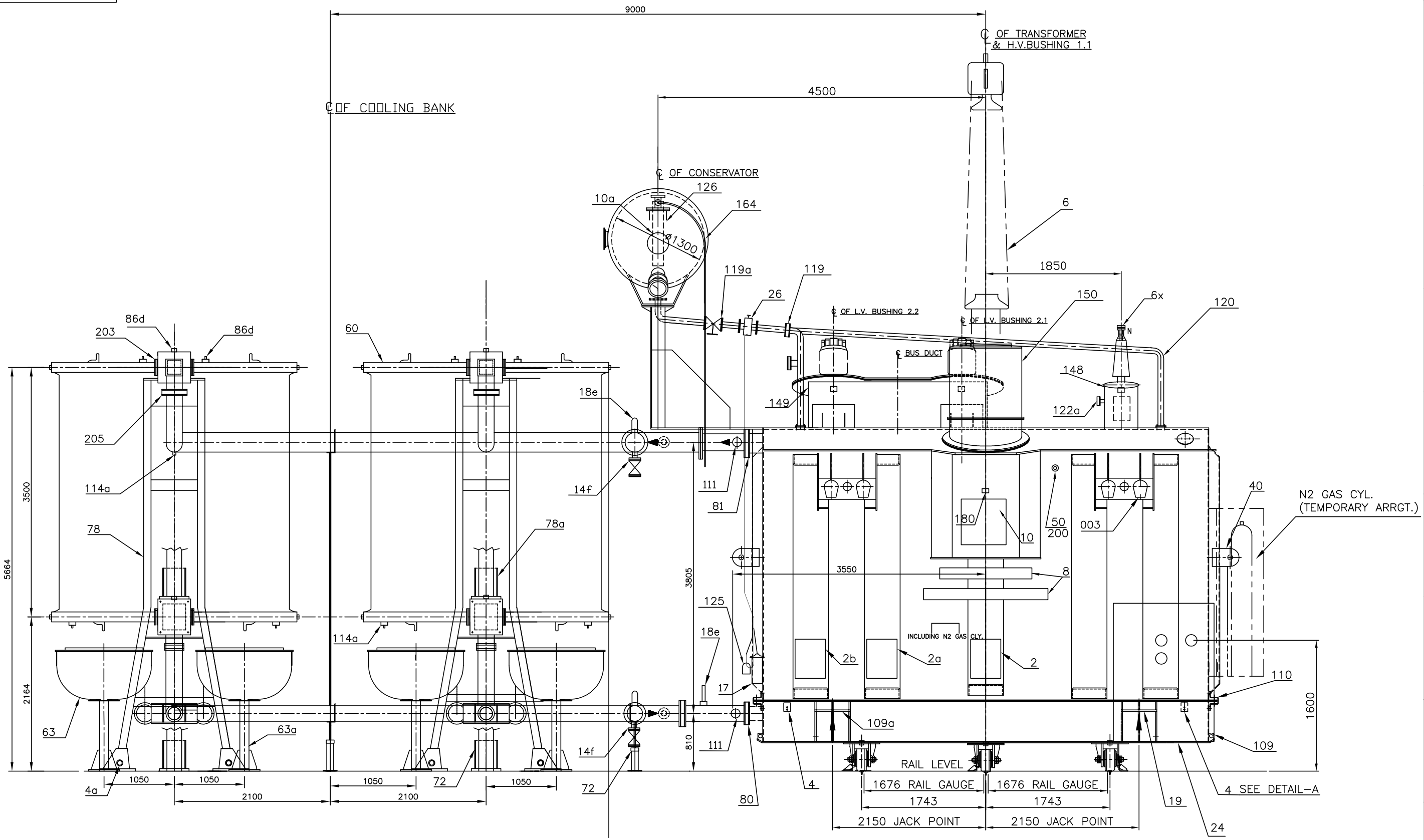
(ALL DIMENSIONS ARE IN mm)

3 452 00 00620

REF. DRG. NO. 3452000458/02

SIGN.DATE

INVENTORY NO.



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REV	DATE	ALT	RAKESH		REV	DATE	ALT	RAKESH	
02	21-10-11	CKD	S.N.J		01	15-10-11	CKD	S.N.J	
		APPD	A.K.P				APPD	A.K.P	
ZONE	SHEET 2 REVISED.				ZONE	DRG. REVISED AS PER CUSTOMER COMMENTS.			

MASTER DRAWING NO.	BP-DG-330-301-001
NO. OF TRANSFORMER	4
PROJECT	1X600 MW KAKATIA TPS ST-II
LOA NO.	TM 0816/CPP/711/KTPP-II/D.NO. 507/2008 DT. 13.10.2008
TYPE OF PRODUCT	240MVA,21/400/√3 KV,1-PH. ONAN/ONAF/OFAF GEN.TRANSF.
NAME OF CUSTOMER	M/S. APGENCO LTD.

ADDITIONAL INFORMATION
W.O.-68109-A-512-01
STATUS OF DRAWING "U"
DISTRIBUTION OF PRINTS
TRE-1,TRM-3,TRX-1

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406		COMP.SCALE-

TITLE **OUTLINE GENERAL ARRANGEMENT (ELEVATION)**

	NAME	SIGN	DATE
DRN.	RAKESH		
CHD.	S.N.J.		
APPD.	A.K.P.		

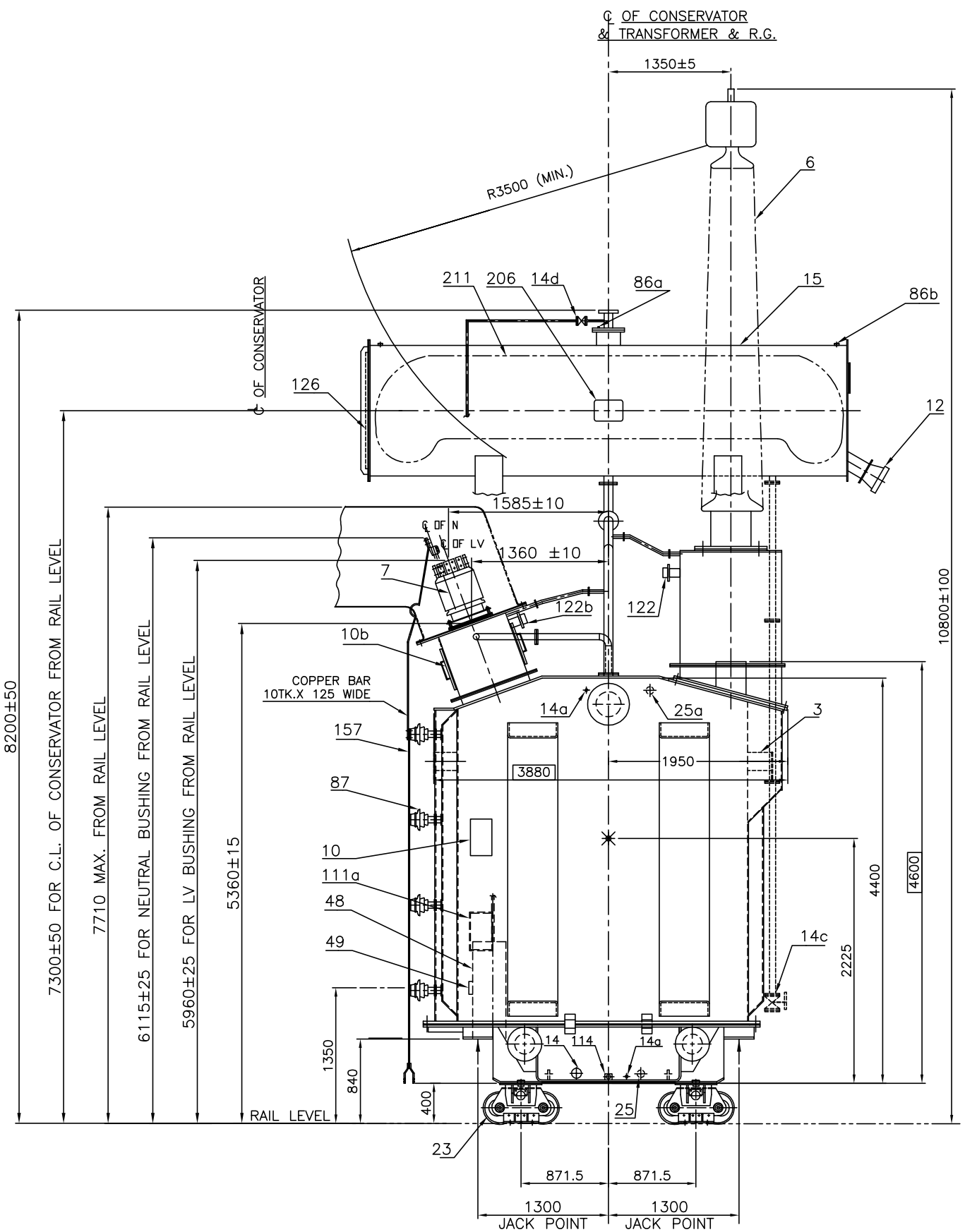
DRG. NO. **3 452 00 00620** REV. **02**

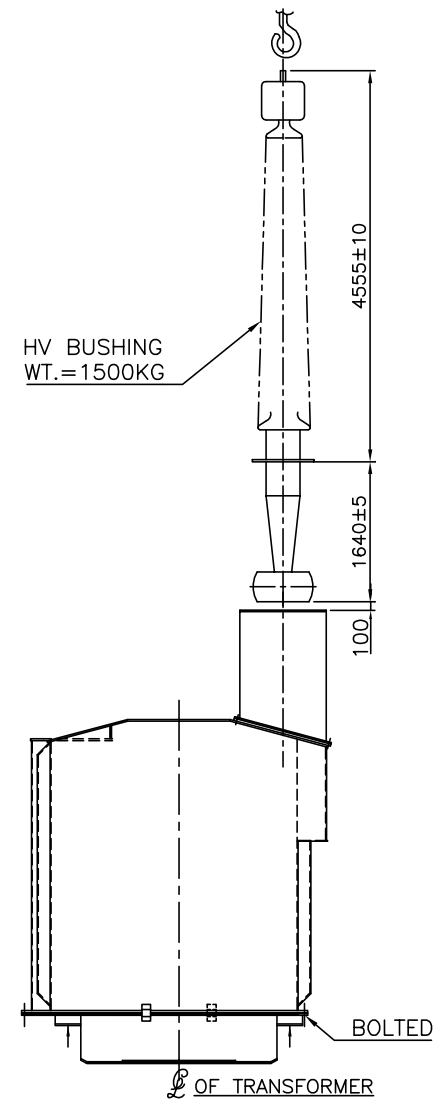
SHEET **01** OF **03**

FIRST ANGLE PROJECTION

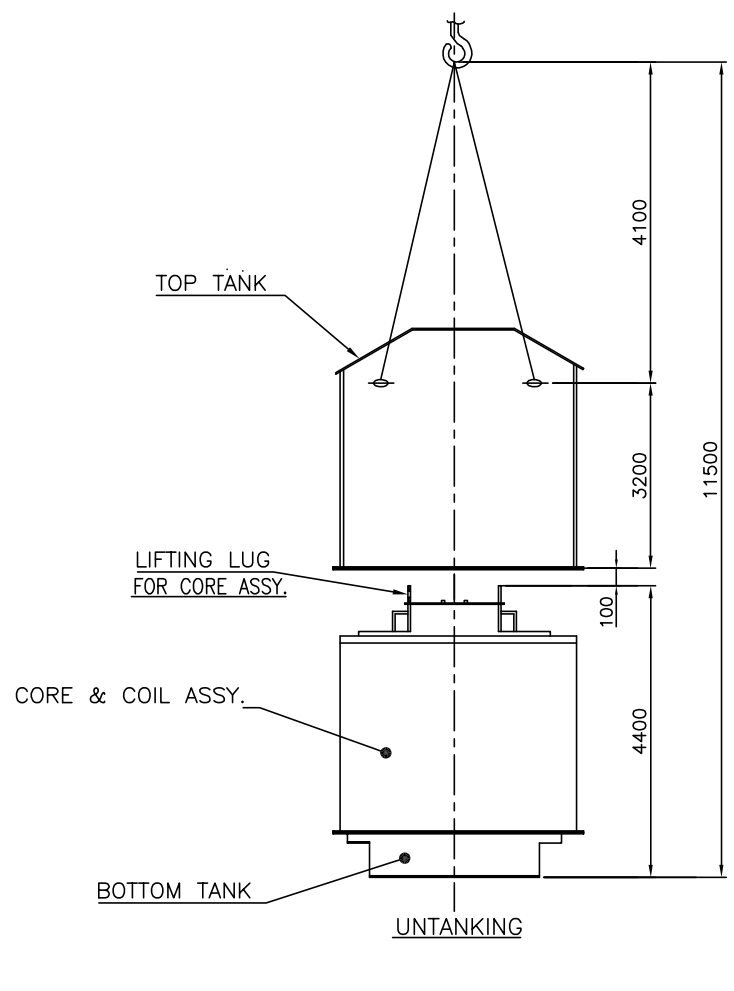
(ALL DIMENSIONS ARE IN mm)

3 452 00 00620



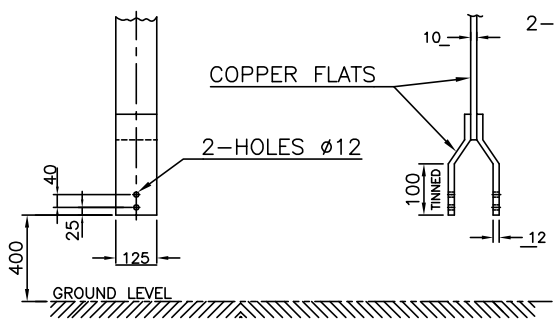


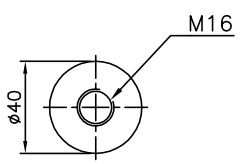
DISCONNECTION HV BUSHING



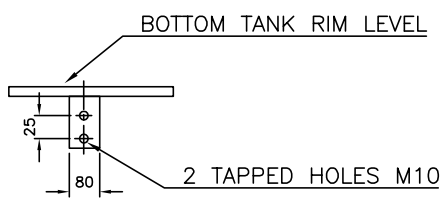
NOTE:-

1- FOR NOTES, REFERENCE DRAWINGS, DETAILS OF WEIGHTS & OIL QUANTITIES AND PART LIST REFER DRG. 3 452 00 00621.
2- WHEN THE TRANSFORMER IS FILLED WITH OIL, EITHER RESTING OR IN MOTION, 6-Nos. OF TWIN BIDIRECTIONAL ROLLERS SHALL BE USED.





DETAIL-B (IT.4a)



DETAIL-A

MIN. AIR CLEARANCES	
H.V. - EARTH	3500
NEUTRAL - EARTH	230

INVENTORY NO.	SIGN.DATE	REF. DRG. NO.
		3 452 00 00458/02

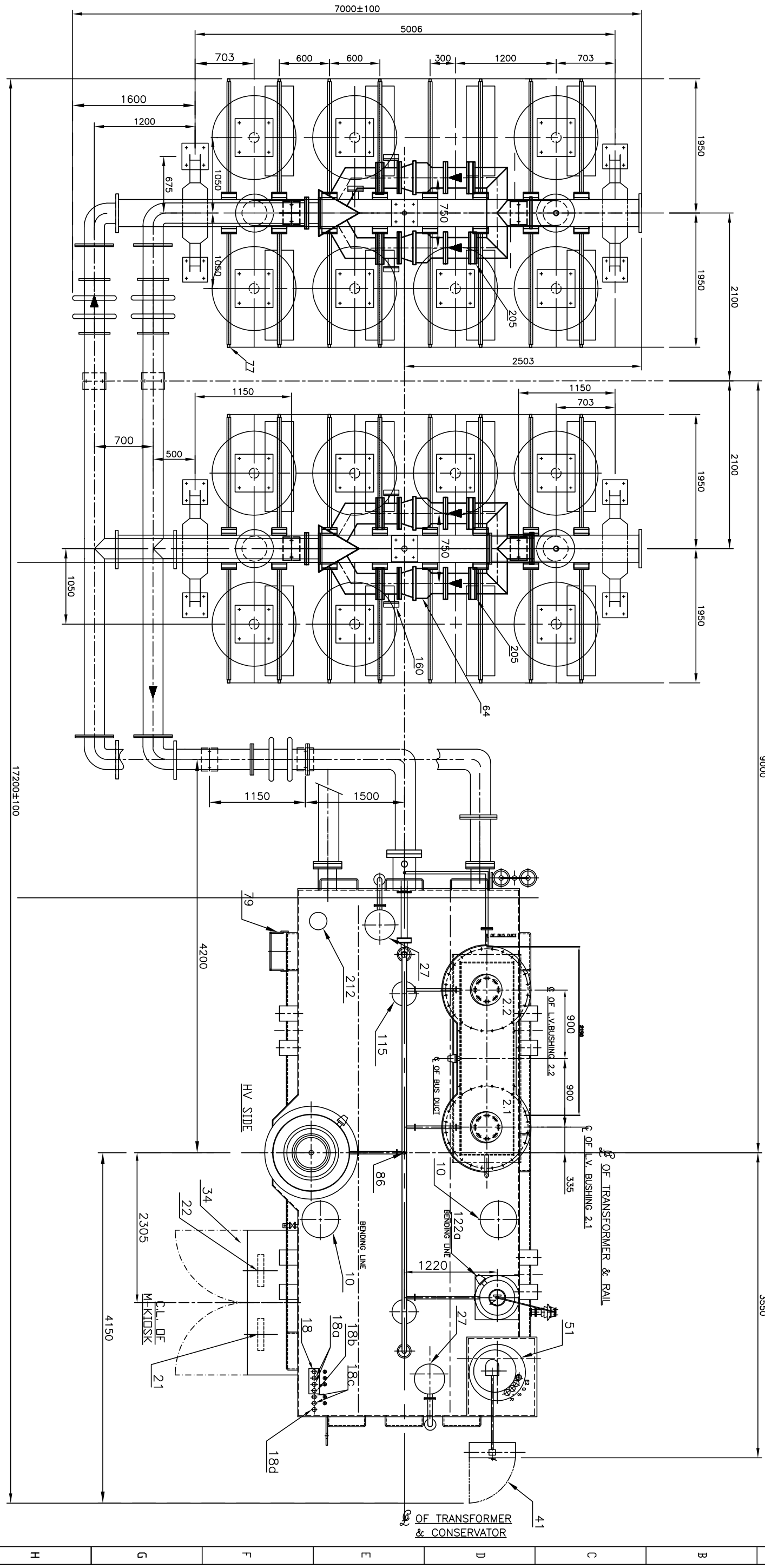
REV	DATE	ALT	RAKESH		REV	DATE	ALT	RAKESH	
02	21-10-11	CKD	S.N.J		01	15-10-11	CKD	S.N.J	
		APPD	A.K.P				APPD	A.K.P	
ZONE	SHEET 2 REVISED.				ZONE	DRG. REVISED AS PER CUSTOMER COMMENTS.			

MASTER DRAWING NO.	BP-DG-330-301-001
NO. OF TRANSFORMER	4
PROJECT	1X600 MW KAKATIA TPS ST-II
LOA NO.	TM 0816/CPP/711/KTPP-II/D.NO. 507/2008 DT. 13.10.2008
TYPE OF PRODUCT	240MVA,21/400/√3 KV,1-PH. ONAN/ONAF/OFAF GEN.TRANSF.
NAME OF CUSTOMER	M/S. APGENCO LTD.

ADDITIONAL INFORMATION	भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल		NAME	SIGN	DATE
W.O.-68109-A-512-01	BHARAT HEAVY ELECTRICALS LTD. BHOPAL	DRN.	RAKESH		
STATUS OF DRAWING "U"	DEPT	CODE	WEIGHT(kg)	SCALE	CHD.	S.N.J.		
DISTRIBUTION OF PRINTS	TRE	406		COMP.SCALE-	APPD.	A.K.P.		
TRE-1,TRM-3,TRX-1	TITLE OUTLINE GENERAL ARRANGEMENT (END)	DRG. NO. 3 452 00 00620	REV. 02
		SHEET 03 OF 03	

INVENTORY NO.	SIGN.DATE	3 452 00 00458/02 REF. DRG. NO.	THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

ZONE	REV	DATE	ALT	RAKESH
	02	21-10-11	CKD	S.N.J
FAN POSITION CHANGED.			APPD	A.K.P
ZONE	REV	DATE	ALT	RAKESH
	01	15-10-11	CKD	S.N.J
DRG. REVISED AS PER CUSTOMER COMMENTS.			APPD	A.K.P



MASTER DRAWING NO.	BP-DG-330-301-001
NO. OF TRANSFORMER	4
PROJECT	1X600 MW KAKATIA TPS ST-II
LOA NO.	TM 0816/CPP/711/KTPP-II/D.NO. 507/2008 DT. 13.10.2008
TYPE OF PRODUCT	240MVA,21/400/$\sqrt{3}$ KV,1-PH. ONAN/ONAF/OFAF GEN.TRANSF.
NAME OF CUSTOMER	M/S. APGENCO LTD.

ADDITIONAL INFORMATION	
W.O.-68109-A-512-01	
STATUS OF DRAWING	"U"
DISTRIBUTION OF PRINTS	
TRE-1,TRM-3,TRX-1	

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406		COMP.SCALE-

TITLE **OUTLINE GENERAL ARRANGEMENT (PLAN)**

	NAME	SIGN	DATE
DRN.	RAKESH		
CHD.	S.N.J.		
APPD.	A.K.P.		

DRG. NO. **3 452 00 00620** REV. **02**

SHEET **02** OF **03**

3 452 00 00620 02

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 3 452 00 00621

CUSTOMER'S REFERENCE DRAWING

DESCRIPTION	DRAWING NO.
OUTLINE GENERAL ARRANGEMENT	3 452 00 00620
OUTLINE GENERAL ARRANGEMENT PART LIST	3 452 00 00621
VALVE SCHEDULE PLATE	3 452 00 00622
420KV, 1600Amp. OPI CONDENSER BUSHING (H.V.)	3 452 00 00623
36KV, 2000Amp. HV NEUTRAL BUSHING (300 CT)	3 452 00 00624
36KV, 15000Amps. L.V. BUSHING	3 452 00 00625
320 DIA TWIN BI-DIRECTIONAL ROLLER	3 452 00 00626
BUS DUCT MOUNTING FLANGE DETAIL	3 452 00 00627
FOUNDATION PLAN	3 452 00 00628
LOADING GAUGE DIAGRAM	3 452 00 00629
RATING AND DIAGRAM PLATE	3 452 00 00630
OVER FLUXING WITHSTAND DURATION CURVE	4 452 00 00048

APPROX. OIL QUANTITY

DESCRIPTION	LITERS
OIL IN TANK AND TURRETS	66000
OIL IN CONSERVATOR	
OIL IN RADIATOR	
OIL IN PIPE WORK & HEADERS	
TOTAL OIL QTY.	66000

WEIGHTS

DESCRIPTION	WT. IN KG.
WEIGHT OF CORE ASSY.	166400
WEIGHT OF WINDING ASSY.	
TANK AND FITTINGS	75470
BUSHING	
MARSHALLING BOX	
PIPE WORK WITH SUPPORT,A FRAME,HEADER&CONSER.	
PUMP, FAN & RADIATOR	
TOTAL OIL	57420
TOTAL WEIGHT INCLUDING OIL	299290
SHIPPING WEIGHT OF TRANSFORMER (GAS FILLED)	192000

CONSERVATOR & ITS PIPE WORK	10a	INSPECTION COVER FOR CONSERVATOR	1
	12	MAGNETIC OIL GAUGE WITH LOLA	1
	14c	DRAIN C.I. VALVE FOR MAIN CONSERVATOR 50 NB	1
	14e	BREATHER CONNECTION GATE VALVE 15 NB FOR MAIN CONSERVATOR	1
	15	OIL CONSERVATOR MAIN (1300 DIA. WITH AIR CELL)	1
	17	DEHYDRATING BREATHER FOR MAIN CONSERVATOR (SILICA GEL TYPE)	1
	26	BUCHHOLZ RELAY 80 NB	1
	86a	AIR RELEASE PLUG (1/4"BSP) FOR AIR CELL ON CONSERVATOR	1
	86b	AIR RELEASE PLUG (3/4"BSP) FOR MAIN CONSERVATOR	2
	119	ISOLATING B/F VALVE FOR BUCHHOLZ RELAY 80NB	1
	119a	ISOLATING C.I. VALVE 80 NB FOR BUCHHOLZ RELAY	1
	120	MAIN CONSERVATOR 80NB PIPE SET.	1
	125	GAS COLLECTING DEVICE	1
	126	PRISMATIC OIL GAUGE	1
	161	BUCHHOLZ GAS RELAY DEVICE PIPE 6 DIA (COPPER)	1
	164	BREATHER PIPE 15 N.B.(FOR MAIN CONSERVATOR)	1
	206	MONOGRAM	1
	211	ATMOSEAL (AIR CELL) ARRGT. OF CONSERVATOR	1
COOLING SYSTEM	4a	BOSS FOR EARTHING BOLT, WASHER & SPRING WASHER M16 FOR 'A' FRAME	4
	14f	DRAIN/FILTER C.I. VALVE 50 NB FOR COOLING SYSTEM	2
	18e	THERMOMETERS ON RADIATOR PIPE WORKS	2
	60	RADIATOR ASSY 2 X 100% RAD. BANK	32
	64	OIL PUMP AND MOTOR	4
	63	FAN & MOTORS DIA 915 (12 + 2 STAND BY)	14
	63a	FAN SUPPORT	14
	67	EXPANSION JOINT 200 & 250 NB (2-EACH)	4
	72	PIPE SUPPORT	6
	77	RADIATOR TIE BAR	56
	78	A-FRAME SUPPORT FOR HEADER	4
	86d	AIR RELEASE PLUG (3/4"BSP) ON RADIATOR,HEADER & PIPE WORK	42
	111	GATE VALVE (40 NB) WITH 1/5" SIZE MAIL THREADED ADDOPTER SUITABLE FOR MOUNTING SENSOR OF DISSOLVED GAS MONITORING SYSTEM.	2
	114a	DRAIN/PLUG (3/4") ON RADIATOR & PIPE WORK	34
	160	OIL FLOW INDICATOR (LEFT TO RIGHT FACING DIAL)	4
	203	RADIATOR VALVE	64
TURRETS & BUSHING	6	H.V. LINE BUSHING (BHEL MAKE)	1
	6x	H.V. NEUTRAL BUSHING (BHEL MAKE)	1
	7	L.V. BUSHING (BHEL MAKE)	2
	10b	INSPECTION COVER L.V. BUSHING CONNECTION	4
	78a	HEADER SUPPORT	4
	122	C.T. TERMINAL BOX FOR H.V.	1
	122a	CT TERMINAL BOX FOR H.V. NEUTRAL	1
	122b	CT TERMINAL BOX FOR L.V.	1
	148	NEUTRAL TURRET	1
	149	L.V. TURRET WITH TOP FLANGE OF NON MAGNETIC STAINLESS STL.	1
	150	H.V. TURRET M.S.	1
	157	NEUTRAL GROUNDING CONNECTOR (COPPER) 10 X 125 WIDE	1
	180	TERMINAL MARKING	4
	181	H.V. TERMINAL CONNECTOR (TWIN MOOSE ACSR)	1
	200	ON LINE GAS MONITORING SYSTEM	1
	205	200 NB B/F VALVE	8

TABLE OF FITTINGS

	ITEM NO.	DESCRIPTION	QTY.
TRANSFORMER	2	RATING AND DIAGRAM PLATE (BILINGUAL)	1
	2a	VALVE SCHEDULE PLATE	1
	2b	DO'S AND DON'T INSTRUCTION PLATE	1
	3	LIFTING BOLLARD (FOR TRANSFORMER WITH OIL) DIA 219 PAIR	4
	4	EARTHING PAD WITH BOLTS,NUTS PLAIN & S. WASHERS M12	2
	8	NAME PLATE HINDI AND ENGLISH (ONE EACH)	2
	9	INSTRUCTION PLATE FOR LIFTING	4
	10	INSPECTION COVER FOR TANK/COVER	3
	14	DRAIN BUTTERFLY VALVE FOR TOTAL DRAINAGE 100 NB	1
	14a	SAMPLING 15 NB G.M. VALVE (1 AT TOP & 1 AT BOTTOM TANK)	2
	14b	40 NB G.M. VALVE FOR SUDDEN PRESSURE RELAY	1
	18	POCKET FOR OIL TEMPERATURE INDICATOR	1
	18a	POCKET FOR WINDING TEMPERATURE INDICATOR	2
	18b	ORDINARY THERMOMETER WITH POCKET	1
	18c	POCKET WITH RTD-WTI	2
	18d	POCKET FOR RTD-OTI	2
	19	JACKING PAD (SUITABLE FOR TOTAL WEIGHT WITH OIL)	4
	21	O.T.I. (IN C.C. CABINET) WITH REPEATER	1
	22	W.T.I. (IN C.C. CABINET)	2
	23	TWIN BI-DIRECTIONAL ROLLERS	6
	24	SKIDS (BOTH DIRECTIONS)	1
	25	50 NB FILTER C. I. VALVE (BOTTOM)	1
	25a	50 NB FILTER C. I. VALVE WITH SAMPLING ATTACHMENT (TOP)	1
	27	P.R.V. WITH OIL COLLECTOR & DRAIN PIPE	2
	34	COOLER CONTROL CABINET	1
	40	WAGON ANCHORING LUG	4
	50	SUDDEN PRESSURE RELAY	1
	79	LADDER WITH LOCKING DEVICE	1
	80	OIL INLET BUTTER FLY VALVE 200 NB	2
	81	OIL OUTLET BUTTER FLY VALVE 250 NB	1
	86	AIR RELEASE VALVE G.M. (1/2" BSP)	1
	87	36 KV POST INSULATOR	4
	109	HAULAGE LUG 50 DIA . LONGITUDINAL	4
	109a	HAULAGE LUG 50 DIA . TRANSVERSAL	4
	110	TOP TANK AND BOTTOM TANK SHORTING LINK	2
	111a	MOUNTING BRACKET FOR MOUNTING OF ELECTRONIC ENCLOSER WITH DESSOLVED GAS MONITORING SYSTEM .	2
	114	DRAIN / SAMPLING PLUG (1" BSP) ON EACH SIDE OF BOTTOM TANK	2
	115	HOLE FOR CLAMPING CORE AND COIL TO TOP TANK	2
	200	40 NB GATE VALV FOR SPR	1
	212	10 KV EARTHING TER. BORD (CORE & END FRAME TO TANK EARTHING)	1
OFF CIRCUIT TAP SWITCH	41	BEVEL GEAR BOX	1
	48	OFF CIRCUIT TAP SWITCH DRIVING UNIT	1
	49	OFF CIRCUIT TAP SWITCH DRIVING HANDLE	1
	51	OFF CIRCUIT TAP SWITCH	1

NOTES:-

1. WHEN REFERING THE O.G.A DRG. PLEASE QUOTE MVA & W.O. N.O.
2. DIMENSIONS SHOWN THUS ARE OVERALL SHIPPING DIMENSIONS.
3. TRANSFORMER OIL SHALL BE SUPPLIED CONFIRMING TO IS : 335.
4. THE DESIGN FEATURES SHOWN ON THIS DRAWING (GENERALLY IN LINE WITH IS IS-2026 AND AGREED CUSTOMER SPECIFICATION) MEET THE STATUTORY, REGULATORY & SAFETY REQUIREMENTS WITH RESPECT TO EARTHING ARRANGEMENT & DANGER LABLES, AND CLEARANCES IN AIR, PROVISIONS FOR PRESSURE RELIEF DEVICE, GAS AND OIL ACTUATED RELAY AND ANTI EARTHING QUAKE CLAMPING ARRANGEMENT.
5. WEIGHTS AND VOLUME ARE FINAL.
6. PAINT SHADE SHALL BE SHADE NO 631 OF IS-5.

REV	DATE				REV	DATE			
		ALT			01	15-10-11	ALT	RAKESH	
		CKD					CKD	S.N.J	
		APPD					APPD	A.K.P	
ZONE					ZONE	DRG. REVISED AS PER CUSTOMER COMMENTS.			

MASTER DRAWING NO.	BP-DG-330-301-002
NO. OF TRANSFORMER	4
PROJECT	1X600 MW KAKATIA TPS ST-II
LOA NO.	TM 0816/CPP/711/KTPP-II/D.NO. 507/2008 DT. 13.10.2008
TYPE OF PRODUCT	240MVA, 21/400/√3 KV 1-PH. ONAN/ONAF/OFAF GEN. TRANSF.
NAME OF CUSTOMER	M/S. APGENCO LTD.

ADDITIONAL INFORMATION	
W.O.-68109-A-512-01	
STATUS OF DRAWING	"U"
DISTRIBUTION OF PRINTS	TRE-1,TRM-3,TRX-1

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

DEPT	CODE	WEIGHT(kg)	SCALE
TRE	406		COMP.SCALE-

TITLE **OGA PARTLIST**

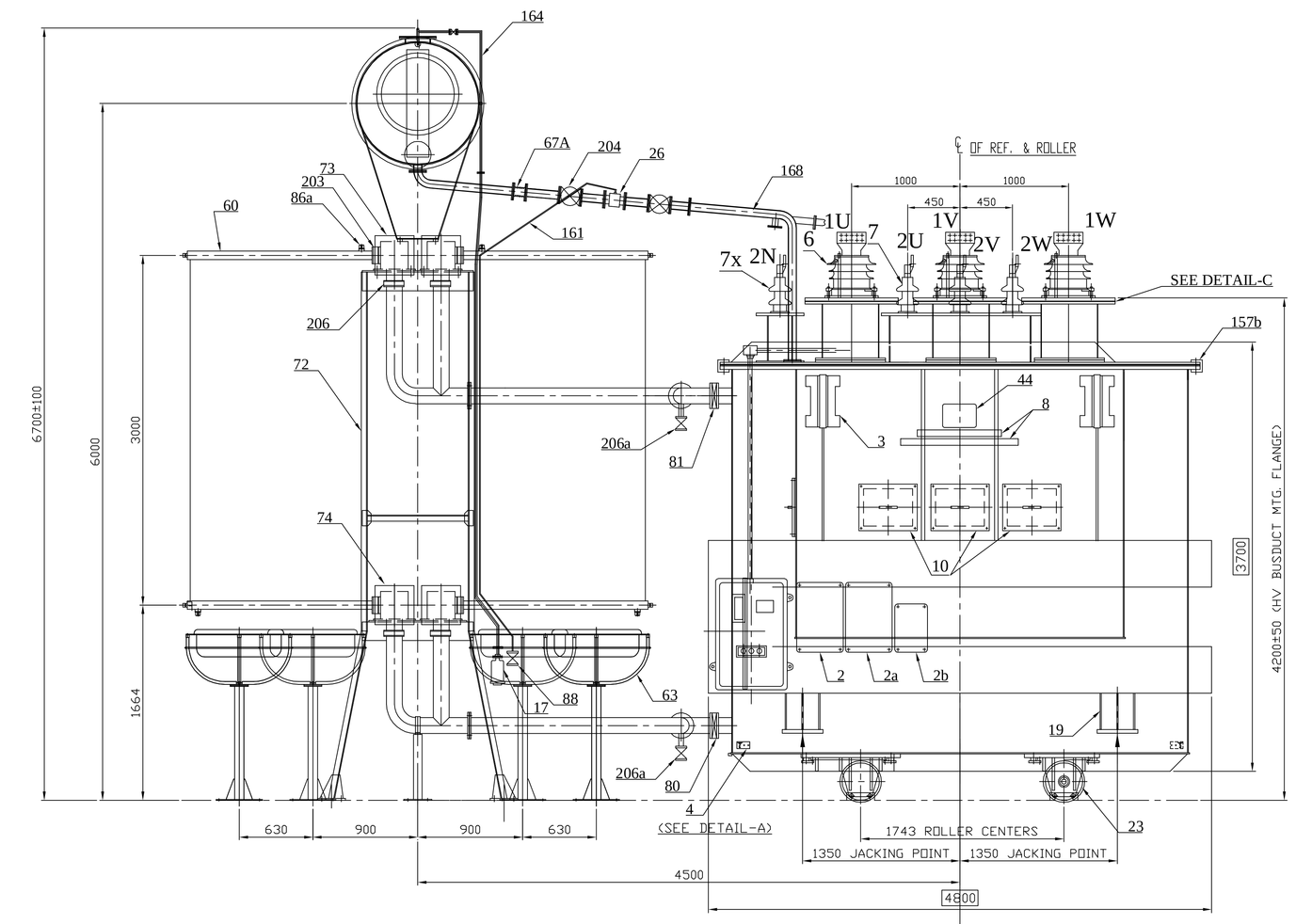
	NAME	SIGN	DATE
DRN.	RAKESH		
CHD.	S.N.J.		
APPD.	A.K.P.		

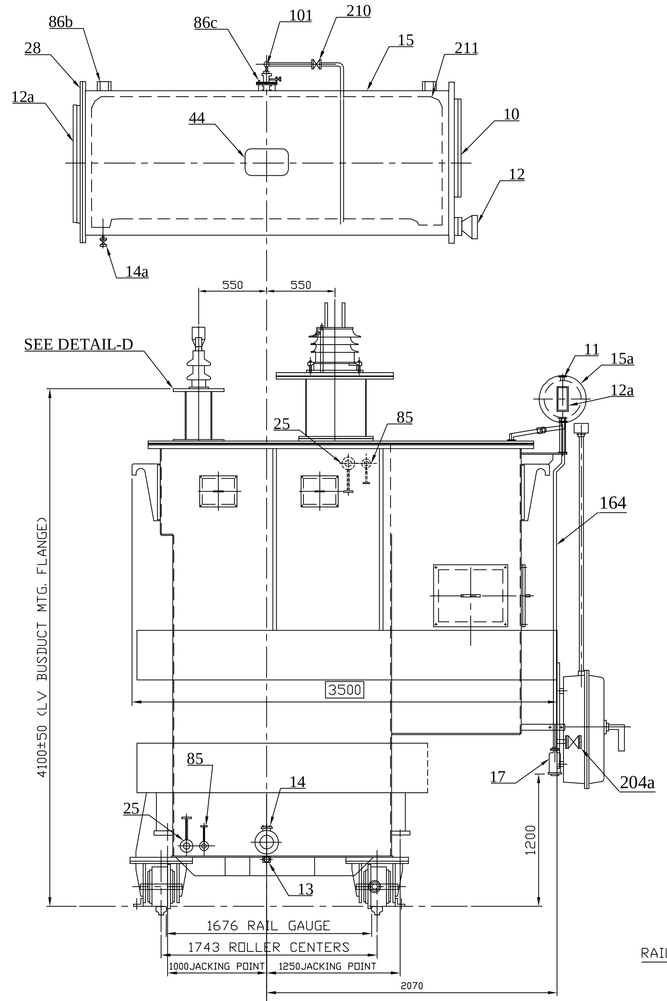
DRG. NO. **3 452 00 00621** REV. **01**

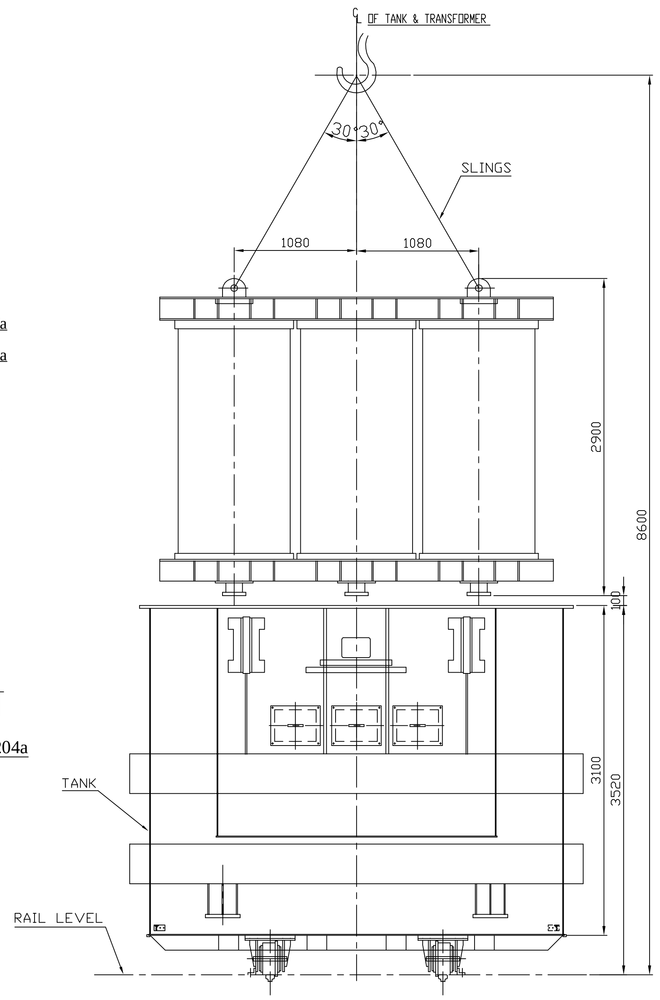
SHEET **01** OF **01**

SIGN.DATE

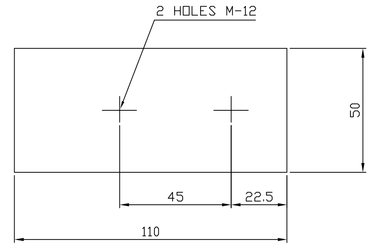
INVENTORY NO.



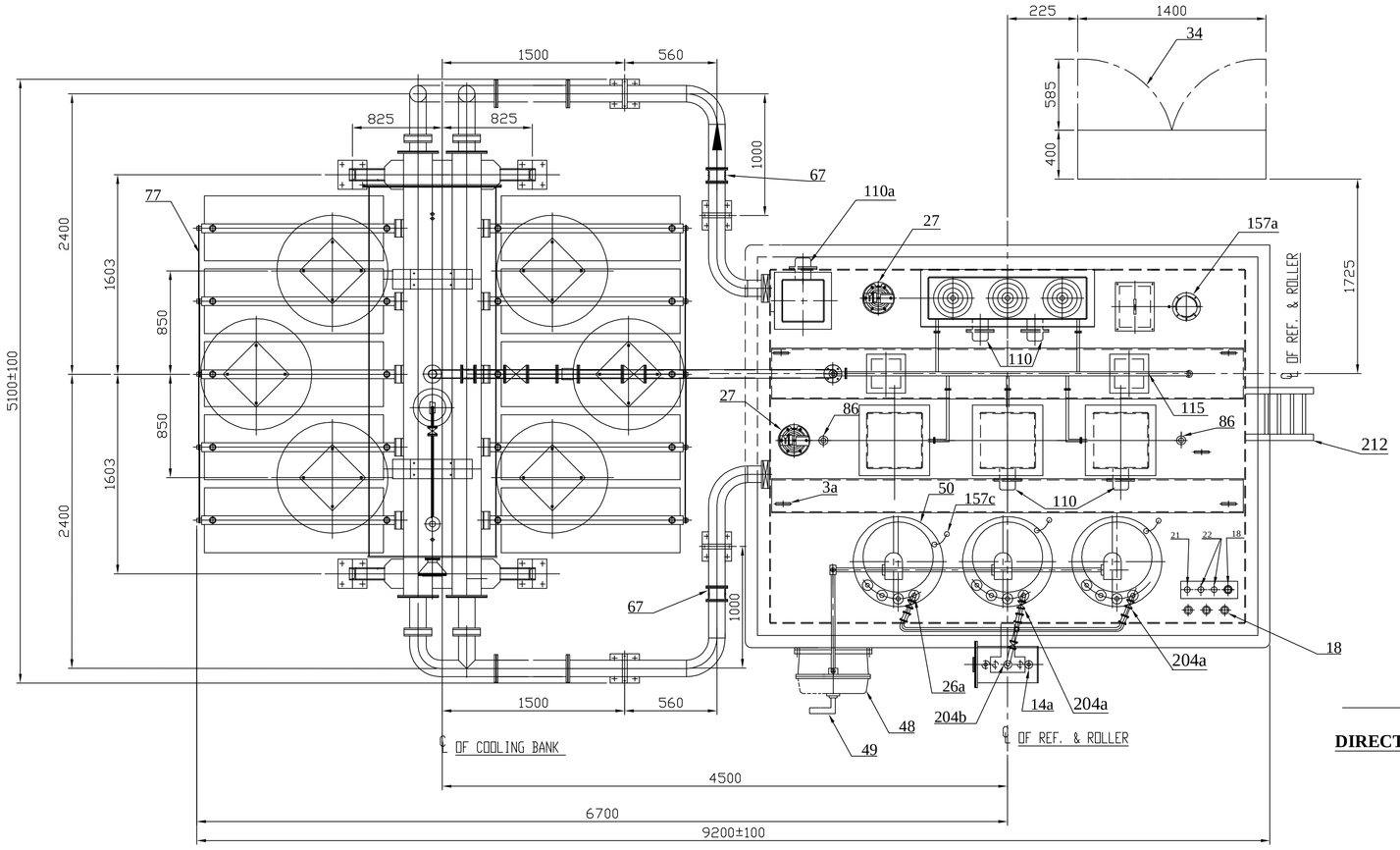




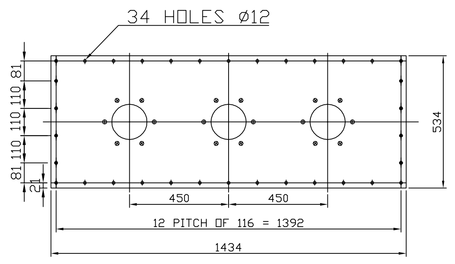
UNTANKING DETAIL



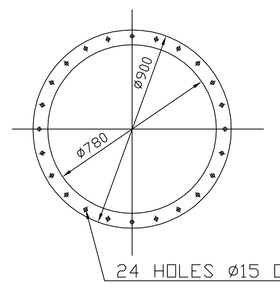
DETAIL - A
(EARTHING DETAIL)



DIRECTION OF WITHDRAWAL



(11.5 KV) L.V. BUSDUCT (SPB) FLANGE DETAIL
DETAIL-D



(21 KV) H.V. BUSDUCT (IPB) FLANGE DETAIL
DETAIL-C

TABLE OF FITTINGS

IT.NO.	DESCRIPTION	QTY. IN.NOS.
2	RATING AND DIAGRAM PLATE	01
2a	VALVE SCHEDULE PLATE	01
2b	OIL FILLING INSTRUCTION PLATE	01
3	LIFTING LUGS ON TANK	04
3a	LIFTING LUGS ON COVER	04
4	EARTHING TERMINALS	02
6	H.V.LINE TERMINAL BUSHINGS 24 KV, 10000 AMP.	03
7	L.V.LINE TERMINAL BUSHINGS 36 KV, 3150 AMP.	03
7x	L.V.N. TERMINAL BUSHINGS 36 KV, 3150 AMP.	01
8	NAME PLATE (HINDI & ENGLISH)	01+01
10	INSPECTION COVERS	09
11	OIL FILLING HOLES ON OLTC CONERVATOR	01
12	MAGNETIC OIL GAUGE WITH LOW OIL LEVEL ALARM FOR MAIN CONSERVATOR	01
12a	PRISMATIC OIL LEVEL GAUGE FOR MAIN & OLTC CONSERVATOR	01+01
13	DRAIN PLUG	11
14	DRAIN VALVE (100 N.B.) BUTTERFLY VALVE ON TANK	01
14a	DRAIN VALVE ON MAIN & AUX. CONSERVATOR	01+01
15	MAIN OIL CONSERVATOR (1000 DIA)	01
15a	AUX. CONSERVATOR FOR OLTC (300 DIA)	01
17	DEHYDRATING BREATHER	02
18	WTI & OTI RTD MTG.	02+01
19	JACKING PAD WITH HOLAGE HOLES 50ø	04
21	OIL TEMP. INDICATOR (150mm DIAL SIZE) WITHOUT REPEATOR + RTD IN MARSHALLING KIOSK	01+01
22	WINDING TEMP. INDICATOR (150 mm DIAL SIZE) WITHOUT REPEATOR+RTD IN MARSHALLING KIOSK	02+02
23	SINGLE FLANGE BI-DIRECTIONAL ROLLERS 320ø WITH STOPPER ARRGT.	04
25	FILTER VALVE (50 N.B.)	02
26	BUCHHOLZ RELAY	01
26a	OIL SURGE RELAY FOR O.L.T.C.	03
27	PRESSURE RELEASE DEVICE (SPRING LOADED TYPE)	02
28	END COVER FOR MAIN CONSERVATOR WITH PRISMATIC OIL GAUGE	01
34	MARSHALLING KIOSK (FLOOR-MOUNTED)	01
44	COMPANY'S MONOGRAM ON TANK AND CONSERVATOR	02
48	MOTOR DRIVING GEAR BOX OF OLTC	01
49	HAND OPERATING HANDLE FOR OLTC GEAR BOX	01
50	ON LOAD TAP CHANGER (3XMI TYPE)	01
60	RADIATORS (2X50 % BANK MOUNTED)	10
63	COOLING FAN WITH SUPPORT (24" SIZE) (RUNNING + STANBY)	04+02
67	FLEXIBLE JOINT 150 N.B.	02
67A	FLEXIBLE JOINT 80N.B.	01
72	RADIATOR SUPPORT 'A' FRAME	01
73	TOP HEADERS	01
74	BOTTOM HEADERS	01
77	RADIATOR TIE BARS	20
80	OIL INLET VALVE 150 N.B. BUTTERFLY TYPE	01
81	OIL OUTLET VALVE 150 N.B. BUTTERFLY TYPE	01
85	SAMPLING VALVE 15 N.B.	02
86	AIR RELEASE PLUG 15 N.B.	02
86a	AIR RELEASE PLUG	10
86b	AIR RELEASE PLUG	02
86c	AIR RELEASE PLUG	01
88	BUCHHOLZ GAS REALEASE COCK	01
101	PRESSURE GAUGE (0 TO 0.6 Kg/M^2) ON MAIN CONSERVATOR	01
110	WTI & RTD CT TERMINAL BOARD ON L.V & HV BUSHING TURRET	02+02
110a	PROTECTION CT BOARD ON L.V.N BUSHING TURRET	01
115	LOCKING ARRGT. CORE ASSY.TO TANK COVER	02
157a	EARTHING CONNECTION BETWEEN CORE TO END FRAME & END FRAME TO TANK COVER	01
157b	EARTHING CONNECTION BETWEEN TANK TO COVER	02
157c	EARTHING CONNECTION BETWEEN TAP CHANGER TO TANK COVER	03
161	BUCHHOLZ GAS RELEASE PIPE 6 N.B.	01
164	BREATHER PIPE 15 N.B.	02
168	CONSERVATOR PIPE (80N.B.)	01
203	RADIATOR VALVE (80 N.B.)	20
204	CONSERVATOR SHUT-OFF VALVE (80 N.B.)	02
204a	OLTC RELAY SHUT-OFF VALVE (25NB) & TAP CHANGER FILTER VALVE	03+03
204b	OLTC CONSERVATOR SHUT-OFF VALVE (25NB)	01
206	VALVE FOR DISCONNECTING RADIATOR BANK (150 N.B.)	04
206a	50 N.B. FILTER VALVE FOR HEADER	02
210	VALVE FOR BREATHER 15 NB ON MAIN CONSERVATOR	01
211	AIR CELL FOR MAIN CONSERVATOR	01
212	LADDER ASSY.	01

TABLE FOR REFERANCE DRAWINGS

SL. NO.	DESCRIPTION	DRG.NO.
01	OUTLINE GENERAL ARRANGEMENT	04560050332
02	RATING & DIAGRAM PLATE	14561951113
03	FOUNDATION PLAN FOR TRANSFORMER	14560050756
04	24 KV, 10000 AMP. HV BUSHING	34560051461
05	36 KV 3150 AMP. L.V. & LVN BUSHING.	34560051462
06	FOUNDATION PLAN FOR 320 DIA. ROLLERER	34560051463
07	OIL FILLING INSTRUCTION PLATE	24561950959
08	VALVE SCHEDULE PLATE	14561951114

APPROXIMATE WEIGHTS

DESCRIPTION	APPROX.WT IN KG.
CORE AND WINDING (INCLUDING OIL ABSORBEDD)	30000
TANK AND FITTINGS (INCLUDING ROLLERS,OLTC,COOLING BANK)	27000
OIL QUANTITY IN LITER	28000
WEIGHT OF OIL	25000
TOTAL WEIGHT	82000
SHIPPING WEIGHT (N2 GAS FILLED)	45000
UNTANKING WEIGHT	30000

NOTES:-

1. FINAL COAT OF PAINTING ON TRANSFORMER IS POLYURETHANE SHADE NO. 631 OF IS 5
2. DIMENSIONS MARKED THUS [ ] ARE OVER ALL SHIPPING DIMENSIONS EXCLUSIVE OF PACKING.
3. WHEN REFERING THIS DRG. STATE MVA & W.O.No.18204N18000 .
4. FOR OLTC DIVERTER SWITCH DETAIL REFER OLTC MANUAL.
5. CABLE WIRING UP TO M- KIOSK ARE SUPPLIED BY BHEL JHANSI BUT NOT SHOWN IN OGA FOR CLEARITY .
6. WEIGHTS GIVEN IN TABLE ARE TENTATIVE ONLY FINAL WT SHALL BE UPDATED IN AS BUILT DRG.

REV	DATE	ALTERED / CHECKED
01	13.09.10	CHECKED

DRG. REVISED AS PER CUSTOMER'S COMMENTS DATED-27.8.2010 & BHEL PEM COMMENTS DATED-01-07-2010.

P.O. NO.	TM 0816/CPP/711/KTPP-II/D.NO. 507/2008
CUSTOMER	APGENCO LTD, HYDERABAD
CUSTOMER'S CONSULTANT	DESEIN PVT. LTD. CONSULTING ENGINEERS NEW DELHI
PROJECT	KAKATIYA TPP STAGE-II -1X600 MW

ADDITIONAL INFORMATION W.O. 18204N18000
STATUS OF DRAWING U U
DISTRIBUTION OF PRINTS TRE-1, TRP-1, BAY1&2-3, BAY9-4,

TYPE OF PRODUCT 31.5/25 MVA, 21/11.5 KV,ONAF/ONAN COOLED 3-PHASE
DR
NAME OF CUSTOMER/PROJECT UNIT TRANSFORMER

BHARAT HEAVY ELECTRICALS LTD. JHANSI

	NAME	SIGN	DATE	NO. OF VAR.
DRN	S.K.YADAV		24.05.10	
CHD	PB			–
APPD	AKG			

DEPT TRE | CODE 406 | GRADE OF UN TOL DIM. GMT | SCALE – – | WEIGHT (KG) | REF. TO ASSY. NO. | ITEM NO. | NO. OF ITEM –

TITLE
OUTLINE GENERAL ARRGT.

CARD CODE

DRAWING NO. 0 456 00 50 332 REV. 01
SHEET NO. 01 NO. OF SHEETS 01

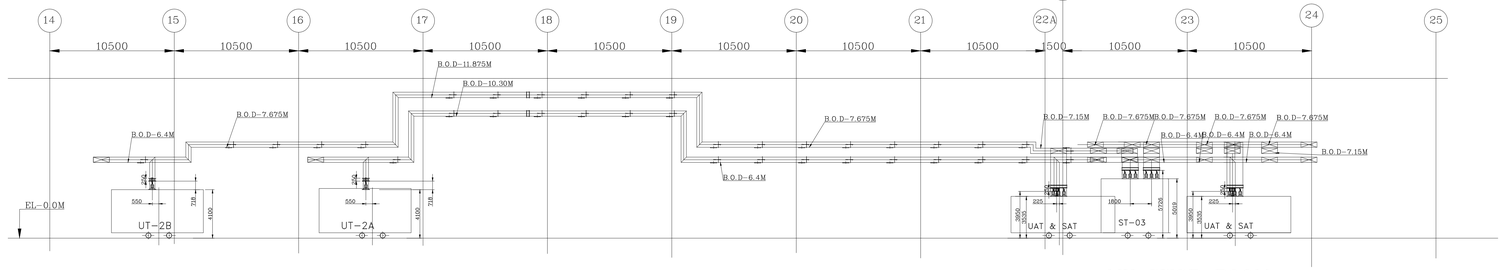
SIZE A0

SIGN & DATE | REF. DRG. NO. PDW012731. DWG | INVENTORY NO.

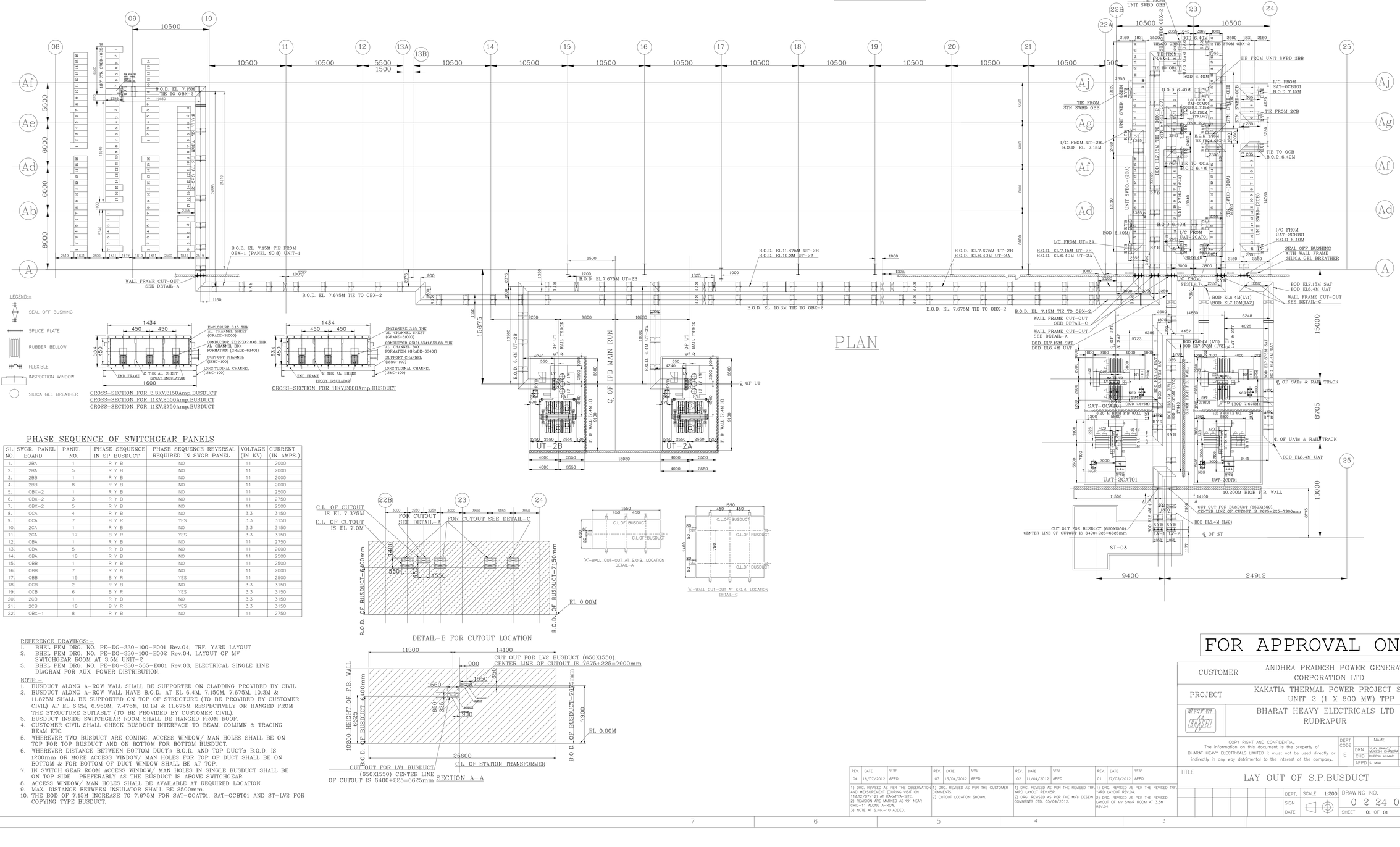
FIRST ANGLE PROJECTION

DRAWING NO. 0 2 24 09 10 001

ELEVATION



PLAN



LEGEND:–

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

CROSS-SECTION FOR 3.3KV,3150Amp.BUSDUCT
CROSS-SECTION FOR 11KV,2500Amp.BUSDUCT
CROSS-SECTION FOR 11KV,2750Amp.BUSDUCT

CROSS-SECTION FOR 11KV,2000Amp.BUSDUCT

PHASE SEQUENCE OF SWITCHGEAR PANELS

SL. NO.	SWGR. BOARD	PANEL NO.	PHASE SEQUENCE IN SP BUSDUCT	PHASE SEQUENCE REVERSAL REQUIRED IN SWGR PANEL	VOLTAGE (IN KV)	CURRENT (IN AMPS.)
1.	2BA	1	R Y B	NO	11	2000
2.	2BA	5	R Y B	NO	11	2000
3.	2BB	1	R Y B	NO	11	2000
4.	2BB	8	R Y B	NO	11	2000
5.	OBX-2	1	R Y B	NO	11	2500
6.	OBX-2	3	R Y B	NO	11	2750
7.	OBX-2	5	R Y B	NO	11	2500
8.	OCA	4	R Y B	NO	3.3	3150
9.	OCA	7	B Y R	YES	3.3	3150
10.	2CA	1	R Y B	NO	3.3	3150
11.	2CA	17	B Y R	YES	3.3	3150
12.	OBA	1	R Y B	NO	11	2750
13.	OBA	5	R Y B	NO	11	2000
14.	OBA	18	R Y B	NO	11	2500
15.	OBB	1	R Y B	NO	11	2500
16.	OBB	7	R Y B	NO	11	2000
17.	OBB	15	B Y R	YES	11	2500
18.	OCB	2	R Y B	NO	3.3	3150
19.	OCB	6	B Y R	YES	3.3	3150
20.	2CB	1	R Y B	NO	3.3	3150
21.	2CB	18	B Y R	YES	3.3	3150
22.	GBX-1	8	R Y B	NO	11	2750

DETAIL-B FOR CUTOUT LOCATION

REFERENCE DRAWINGS :–

1. BHEL PEM DRG. NO. PE-DG-330-100-E001 Rev.04, TRF. YARD LAYOUT
2. BHEL PEM DRG. NO. PE-DG-330-100-E002 Rev.04, LAYOUT OF MV SWITCHGEAR ROOM AT 3.5M UNIT-2
3. BHEL PEM DRG. NO. PE-DG-330-565-E001 Rev.03, ELECTRICAL SINGLE LINE DIAGRAM FOR AUX. POWER DISTRIBUTION.

NOTE :–

1. BUSDUCT ALONG A-ROW WALL SHALL BE SUPPORTED ON CLADDING PROVIDED BY CIVIL.
2. BUSDUCT ALONG A-ROW WALL HAVE B.O.D. AT EL 6.4M, 7.150M, 7.675M, 10.3M & 11.875M SHALL BE SUPPORTED ON TOP OF STRUCTURE (TO BE PROVIDED BY CUSTOMER CIVIL) AT EL 6.2M, 6.950M, 7.475M, 10.1M & 11.675M RESPECTIVELY OR HANGED FROM THE STRUCTURE SUITABLY (TO BE PROVIDED BY CUSTOMER CIVIL).
3. BUSDUCT INSIDE SWITCHGEAR ROOM SHALL BE HANGED FROM ROOF.
4. CUSTOMER CIVIL SHALL CHECK BUSDUCT INTERFACE TO BEAM, COLUMN & TRACING BEAM ETC.
5. WHEREVER TWO BUSDUCT ARE COMING, ACCESS WINDOW/ MAN HOLES SHALL BE ON TOP FOR TOP BUSDUCT AND ON BOTTOM FOR BOTTOM BUSDUCT.
6. WHEREVER DISTANCE BETWEEN BOTTOM DUCT's B.O.D. AND TOP DUCT's B.O.D. IS 1200mm OR MORE ACCESS WINDOW/ MAN HOLES FOR TOP OF DUCT SHALL BE ON BOTTOM & FOR BOTTOM OF DUCT WINDOW SHALL BE AT TOP.
7. IN SWITCH GEAR ROOM ACCESS WINDOW/ MAN HOLES IN SINGLE BUSDUCT SHALL BE ON TOP SIDE PREFERABLY AS THE BUSDUCT IS ABOVE SWITCHGEAR.
8. ACCESS WINDOW/ MAN HOLES SHALL BE AVAILABLE AT REQUIRED LOCATION.
9. MAX. DISTANCE BETWEEN INSULATOR SHALL BE 2500mm.
10. THE BOD OF 7.15M INCREASE TO 7.675M FOR SAT-OCA101, SAT-OCB101 AND ST-LV2 FOR COPYING TYPE BUSDUCT.

FOR APPROVAL ONLY

CUSTOMER	ANDHRA PRADESH POWER GENERATION CORPORATION LTD
PROJECT	KAKATIA THERMAL POWER PROJECT STAGE-II UNIT-2 (1 X 600 MW) TPP
	BHARAT HEAVY ELECTRICALS LTD RUDRAPUR

DEPT CODE		NAME	SIGN	DATE
E	DRN	VIJAY RAWAT/ MUKESH CHANDRA		24/09/2015
	CHD	RUPESH KUMAR		24/09/2015
	APPD	S. MINJ		24/09/2015

REV.	DATE	CHD	REMARKS
04	16/07/2012	APPD	1) DRG. REVISED AS PER THE OBSERVATION AND MEASUREMENT DURING VISIT ON 11&12/07/12) AT KAKATIYA-SITE. 2) REVISION ARE MARKED AS '04' NEAR GRID-11 ALONG A-ROW. 3) NOTE AT S.No-10 ADDED.
03	13/04/2012	APPD	1) DRG. REVISED AS PER THE CUSTOMER COMMENTS. 2) CUTOUT LOCATION SHOWN.
02	11/04/2012	APPD	1) DRG. REVISED AS PER THE REVISED TRF YARD LAYOUT REV.05F. 2) DRG. REVISED AS PER THE M/s DESEIN COMMENTS DTD. 05/04/2012.
01	27/03/2012	APPD	1) DRG. REVISED AS PER THE REVISED TRF YARD LAYOUT REV.04. 2) DRG. REVISED AS PER THE REVISED LAYOUT OF MV SWGR ROOM AT 3.5M REV.04.

TITLE: LAY OUT OF S.P.BUSDUCT

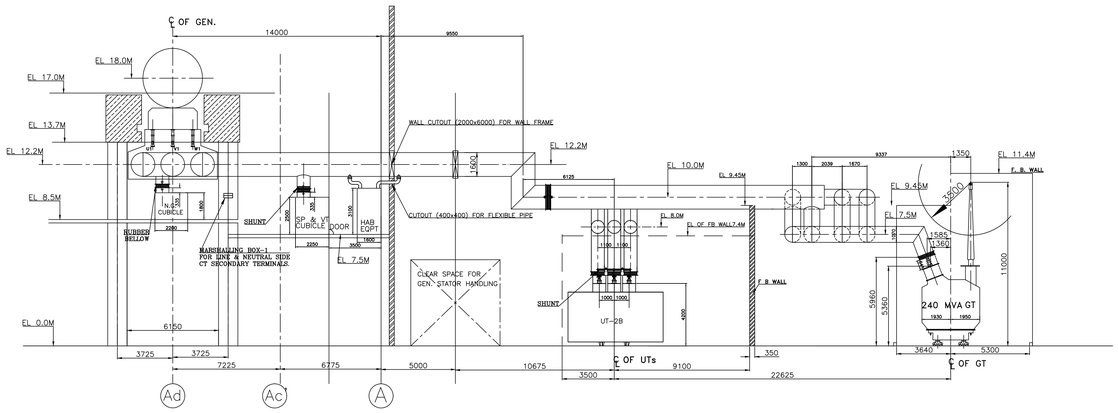
DEPT. | SCALE 1:200 | DRAWING NO. 0 2 24 09 10 001

SIGN | DATE | SHEET 01 OF 01 | REV. 04

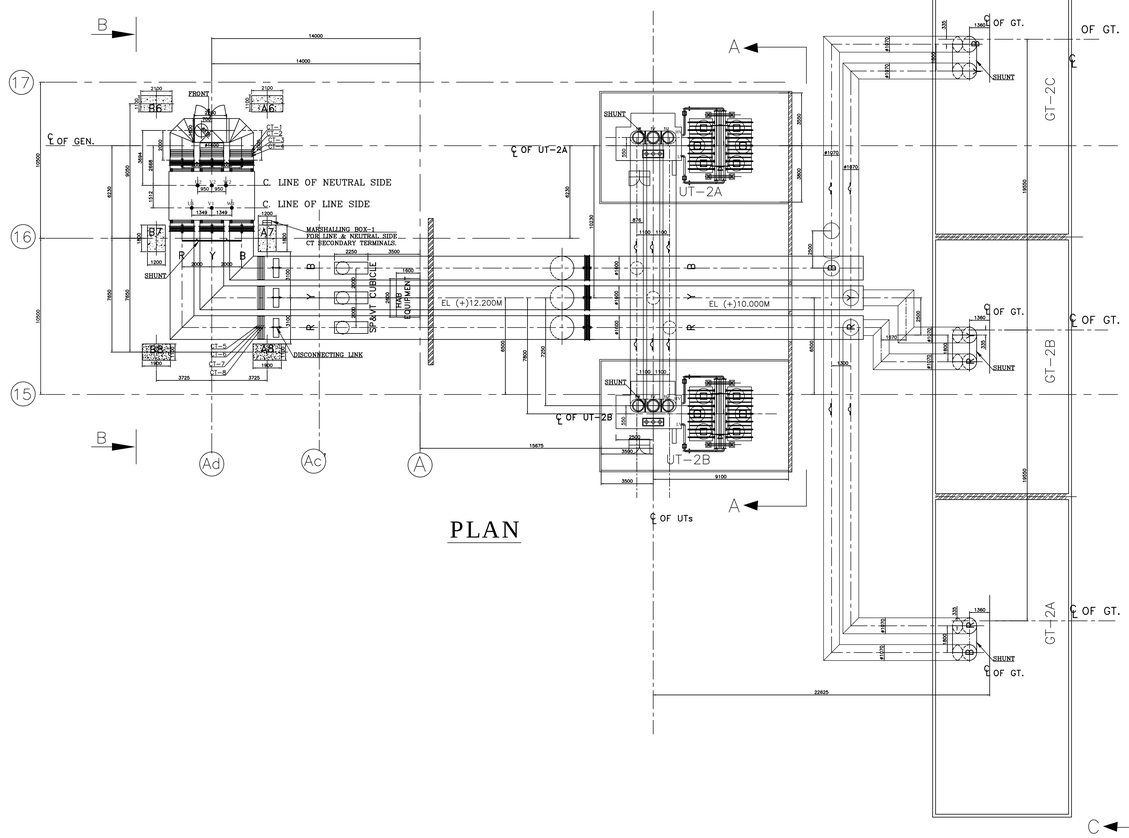
SIZE-A0

ELECTRONIC FILE NAME

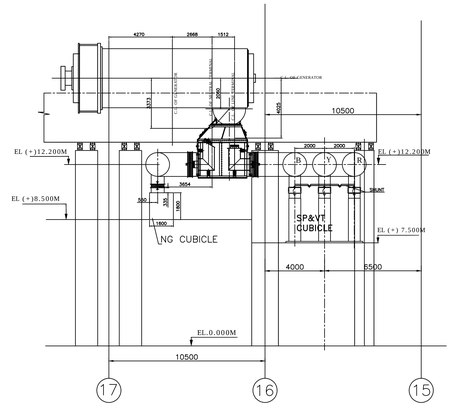
NORTH



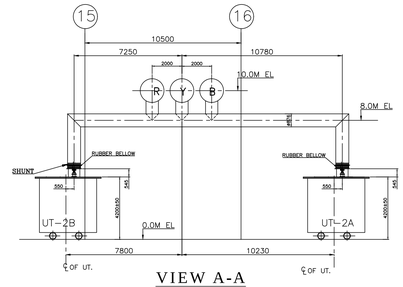
ELEVATION



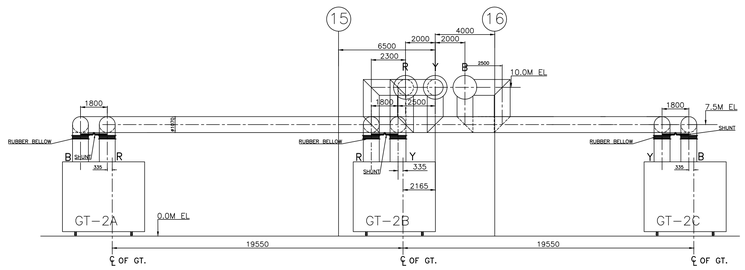
PLAN



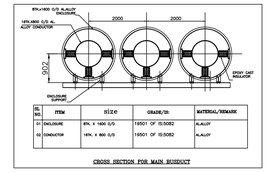
VIEW B-B



VIEW A-A

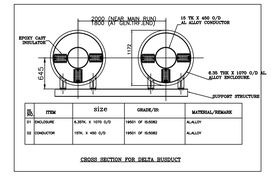


VEIW C-C



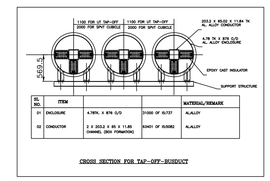
SL NO.	ITEM	size	GRADE/ID.	MATERIAL/REMARK
01	ENCLOSURE	876 X 1800 D/S	19501 OF IS:5082	AL.ALLOY
02	CONDUCTOR	140% X 800 D/S	19501 OF IS:5082	AL.ALLOY

CROSS SECTION FOR MAIN BUSDUCT



SL NO.	ITEM	size	GRADE/ID.	MATERIAL/REMARK
01	ENCLOSURE	8.0TK X 1070 D/S	19501 OF IS:5082	AL.ALLOY
02	CONDUCTOR	120% X 450 D/S	19501 OF IS:5082	AL.ALLOY

CROSS SECTION FOR DELTA BUSDUCT



SL NO.	ITEM	MATERIAL/REMARK
01	ENCLOSURE 4.76TK X 876 D/S	IS:5082 OF IS:737 AL.ALLOY
02	CONDUCTOR 2 X 203.2 X 45 X 11.65 CHANNEL (BOX FORMATION)	IS2401 OF IS:5082 AL.ALLOY

CROSS SECTION FOR TAP-OFF-BUSDUCT

LEGEND

- SEAL-OFF-BUSHING
- RUBBER BELLOW
- FLEXIBLE JOINT
- DISCONNECTING LINK
- CURRENT TRANSFORMER
- CONDUCTOR WELDED JOINT
- SHUNT
- INSPECTION WINDOW
- MAKE UP PIECE WITH INSPECTION WINDOW

REFERENCE DRAWINGS.-

1. TRANSFORMER YARD LAY OUT DRG.NO. PE-DG-330-100-E001 Rev.03.
2. SLD FOR GENERATOR CIRCUIT METERING AND PROTECTION DRG. NO. PE-DG-330-510-E001 Rev.00

FOR APPROVAL ONLY

CUSTOMER	ANDHRA PRADESH POWER GENERATION CORPORATION LTD
PROJECT	KAKATIA THERMAL POWER PROJECT STAGE-II UNIT-2 (1 X 600 MW) TPP
	BHARAT HEAVY ELECTRICALS LTD RUDRAPUR

DEPT CODE		NAME	SIGN	DATE
BDE	DESN	VIJAY RAWAT		
	CHD	RUPESH KUMAR		
	APPD	S. MINJ		

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
02	14/01/12				01	09/12/11			
DRG. REVISED AS PER PEM-COMMENTS REVISED.					DRG. REVISED AS PER THE REVISED TRF. YARD LAYOUT REV.03.				

TITLE: LAY OUT OF I.P. BUSDUCT

DEPT.	SCALE 1:200	DRAWING NO. 0 1 23 09 10 001
SIGN		
DATE		SHEET 1 OF 1 REV. 01

SIZE-A0

ELECTRONIC FILE NAME: D:\KAKATIYA\903\IPB\LAYOUT\KAKATIYA IPB Layout-01230910001 Rev.02.dwg